Modified Delphi study to determine the components of a Medical Cache required for local or international medical deployment after a major incident or disaster

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Table of Contents

PART: A

Declaration

I, **Nadine Seymour**, hereby declare that the work on which this dissertation / thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Acknowledgments

I would firstly like to thank all the experts that were consulted, that gave their valuable time and support to participate in this study to identify the medical equipment and pharmacological agents for inclusion into this medical cache.

I would also like to thank and acknowledge the expertise, time and encouragement from my supervisors Dr Wayne Smith and Dr Heike Geduld throughout this process, it is very much appreciated.

Dedication

I would like to dedicate this dissertation to Samantha, and my family, the Seymour's; the Le Combre`s; the Marais and the Boettgers, for their patience, love and continued support throughout this process.

Competing Interests

None

Definitions

ABG: Arterial Blood Gas Machine

AED: Automated external defibrillator

ALS: Advanced Life Support

BVM: Bag-valve-mask

CRED: Centre for Research on Epidemiology of Disasters

ECG: Electrocardiogram

EDD: Oesophageal Detector Device

EMS: Emergency Medical Services

FEMA: Federal Emergency Management Agency

HPCSA: Health Professions Council of South Africa

HREC: Human Research and Ethics Committee

IDMC: Internal Displacement Monitoring Centre

ILS: Intermediate Life Support

INSARAG: International Search and Rescue Advisory Group

INSARAG MWG: International Search and Rescue Advisory Group Medical Working Group

KED: Kendrick Extrication Device

METRO: Medical Emergency Transport and Rescue Organisation

MDV: Multi-dose Vial

NGO: Non-governmental Organisation

OCHA: Office for the Coordination of Humanitarian Affairs

PEEP: Positive-end-expiratory-device

PPE: Personal Protective Equipment

SEEBA: Schnell-Einsatz-Einheit Bergung Ausland (Rapid Deployment Unit)

UCT: University of Cape Town

USAR: Urban Search and Rescue

ABSTRACT

Background: Disasters occur without warning; they have the potential to cause chaos and destruction in unsuspecting communities and on the environment. The personnel of the Western Cape Emergency Medical and Rescue Services are suitably trained to respond to major incidents or disasters, but lack the support of a standardised medical cache. This in turn compromises the preparedness of such a team to deploy to major incidents and or disasters inside and outside the provincial boundaries.

Aim: This study was to obtain consensus regarding what such a medical cache should be comprised of, specifically regarding medical equipment and pharmacological agents.

Methodology: A three iteration modified Delphi study was conducted over ten months. During this time selected experts who are currently working in the field of disaster response and emergency medicine, were asked to voluntarily and anonymously complete three iterations of questionnaires. After each iteration the primary researcher collected and analysed the responses for consensus. Consensus was set at 85% so as to formulate the questionnaires for the subsequent iterations.

Results: Consensus was achieved with items like the laryngoscope; rugged electrocardiogram with extra-long leads; scoop stretcher; stokes basket and a KED. Other items such as the Arterial Blood Gas (ABG) machine and the Ultrasound machine did not achieve consensus. Disposable equipment like endotracheal tubes; bandages; intravenous administration sets and dial-a-flow devices were amongst the items to be included in the medical cache, these were based on existing research regarding disposable equipment. The majority of pharmacological agents, such as broad spectrum Antibiotics, Suxamethonium and Fentanyl achieved consensus early on; while other pharmacological agents like Ondansetron and Thrombolytic agents did unsurprisingly not achieve consensus across any of the iterations.

Conclusion: This study assisted in identifying the necessary medical equipment and pharmacological agents to be included in a medical cache, which would enable medical rescue teams to be prepared prior and during deployment, whether in or outside the borders of the Western Cape, South Africa or internationally.

Chapter 1 Introduction

1.1 Background

The terms Major Incident, Disaster and Complex Humanitarian Emergencies are often used interchangeably. This is most likely due to the lack of a standardised and internationally accepted definition. In the context of this work, the definitions that are being used are as stated below. It is understood that Major Incidents may escalate into a declared disaster. The scope of the work was to look at the constitution of a medical cache that may support medical teams responding to a disaster. It is hoped that such a cache, once established, would also be able to assist at major incidents. The response to a Complex Humanitarian Emergency does not form part of this study as it brings with it often very unique medical demands.

For the purpose of this dissertation the term disaster will be used to encompass the medical cache requirements of both major incidents and disasters.

Major incidents are sudden events that take place within a community and overwhelm the ability of that community to manage the destruction or impact inflicted on that community. They may require external assistance as the number and severity of immediate victims varies.[1]

Disasters by nature are inclined to be cataclysmic and tragic, but whichever word is used to describe these natural or man-made events, they ultimately result in substantial destruction or loss which tends to overwhelm the country's' capacity and ability to cope beyond their attempts at preparedness and mitigation.[2] These disaster events very often may require the engagement of external resources to assist these local communities in search and rescue missions. Disasters tend to affect the community as a whole and not just the immediate victims.

Disasters generally constitute two groups of events, namely natural disasters and disasters due to human activities, also referred to as technological disasters; examples of these can be found in Table 1.[3]

Natural Disasters	**Human Activities**
Cyclones	Terrorist Attacks
Droughts	Accidental / Human Error
Earthquakes	Civil Strife
Floods	Refugees / Internally Displaced
Landslides	Epidemics
Storms	
Volcanic Eruptions	
Wildfires	

Table 1: List of potential natural and human activities (technological) leading to disasters[3]

It has been stated by many authors that due to factors such as the increase in temperatures coupled with the increasing population growth and urbanisation, that environmental degradation is ever increasing, which is resulting in the potential of greater and more frequent natural disasters.[4-7] Along with these are other human activities which have also been on the rise over the past few years, these include terrorism, infectious agents and hazardous materials. Although the impact from these events have mostly been felt in countries such as the United States, Asia and areas of the United Kingdom, Cape Town in South Africa has not been spared, as they too have been subjected to terrorist events such as the bombing of Planet Hollywood[8] and that of the St Elmo's restaurant.[9] Other factors like the economic inequity and cultural tribalism have also lent to the increase in the likelihood of disaster incidents.[7]

Disasters affect many aspects like the costs to health, cost to the individual due to mortality or morbidity for themselves and family as well as loss to property and ultimately cost to the entire community as a whole.

Many disasters occur without warning; and these events have the greatest potential in causing chaos and destruction in unsuspecting communities and their environments.[3] On a daily basis emergency response in the pre-hospital environment proves challenging, and these challenges are further compounded in a disaster situation, especially in the context of resource constraints as is found in South Africa and the Western Cape.[10]

The Western Cape of South Africa is said to be home to more than 5.4 million people on almost 129 370km^3 of land, and the wellbeing of these people lies in the hands of their provincial government.[11]

When disasters strike, Urban Search and Rescue (USAR) teams and medical response teams are requested to deploy as soon as assistance from the affected area has been requested.[12] Delays in the ability to deploy rapidly may be the result of bad planning, the lack of suitably stored equipment that can be deployed along with the team or not being prepared at all.[13]

There are personnel of the Western Cape's Emergency Medical and Rescue Service that are suitably trained so that they may be deployed to major incidents or disasters. There is however no dedicated medical cache to accompany such a rescue team of the Western Cape on a deployment of this nature.

Ineffective resource allocation could limit the ability to deliver timeous resources to inflicted areas in the correct quantities.[14] Once it has been determined what tasking the team received, the appropriate medical equipment and pharmacological agents can be packed in the right quantities in order to avoid early depletion of stock while on deployment, as well as any delays prior to deployment. The quantities of stock to be packed would be dependent on the amount of team members, including the canines and any potential immediate victims found to be entrapped by any fallen structures. This generally applies to humanitarian responses but can also be applied to search and rescue response units deployed to local and national disaster areas as the same principles apply when preparing for deployment.

International agencies such as the Federal Emergency Management Agency (FEMA)[15] and the International Search and Rescue Advisory Group (INSARAG),[16] were amongst the first established agencies to institute a set of guidelines, suggesting the type, amount and cost of medical equipment and pharmacological agents that should be deployed when responding to a disaster site. It could be asked as to why we do not use these already established lists? These lists are based on international needs and experiences as well as what resources are available internationally. As South Africans living in the Western Cape we require medical equipment and pharmacological agents that are best suited to the needs and resources of South Africans. For this reason it is important that a medical cache be developed based on international best practice but tailored to the relevant scope of practice and what resources are locally available.

Responding to disasters is a costly undertaking and the time required to secure the release of the required funds is often very long. As all these processes are time consuming with miles of red tape to unravel, it would be of benefit that the rescue equipment and medical cache be prepared ahead of time, so that deployment is not delayed. The establishment of a medical cache must include protocols for sourcing the medical equipment, pharmacological agents for human and canine use, storage, transportation and accountability.

In order to establish this medical cache, it must firstly be determined what medical equipment and pharmacological agents would be best suited for inclusion. It should also be determined, who will benefit from this cache (e.g. the members of the search and rescue team or the patients; and if patients, would it be those immediately rescued or those that may need assistance later down the line, such as in humanitarian instances?) These decisions will depend on the tasking received by the team as well as the cost to the team or country. The decision on where this medical cache will be housed and who will take responsibility for it must also be determined. The starting point here however, is to determine the list of medical equipment and pharmacological agents (medical cache) required.

In a disaster situation the main goal is to ensure that morbidity and mortality rates are minimised. It is therefore important that national and international coordinated

strategies for risk reduction, risk management and disaster preparedness are implemented to limit potential fatalities and destruction from future events. It is also essential to understand that medical care provided during and after retrieval, influences victim survivability. It is for this reason that when disasters occur that the designated medical response teams have a fully equipped medical cache that will be immediately ready and available for deployment. It would therefore be ideal if caches could be prepared for each type of disaster event, however this is neither cost effective nor appropriate in resource limited areas.

1.2 Previous Response from South Africa

Rescue South Africa is a non-governmental organisation that relies on volunteers and donations and will respond with their cache to any disaster situations worldwide.[17] To date they have responded to 14 documented disasters,[17] which can be found listed in Table 2.

Year	Country of Disaster	USAR	Humanitarian	Aid Assessment
1999	Turkey	X		
2000	Southern Mozambique		X	
2001	India	X		
2002	Democratic Republic of Congo			X
2003	Algeria	X		
2003	Iran	X		
2005	Pakistan	X		
2010	Haiti	X	X	
2010	Congo	X		

Table 2: Rescue South Africa has responded to a number of incidents in the past few years, these include:[17]

Anecdotally there have been many individual rescuers from all over South Africa that have voluntarily assisted and joined various rescue teams including the team of Rescue South Africa on their deployments to various disaster incidents worldwide.

Some of the Western Cape Emergency Medical and Rescue Service personnel have also contributed by voluntarily deploying themselves to these disaster stricken areas, an example of this was the earthquake that struck both Japan and Haiti.

Chapter 2 – Aim and Objectives

2.1 Aim

To inform a medical cache that will incorporate all the relevant equipment and pharmacological agents that will be ready for immediate deployment or within 12 hours of a disaster occurring locally or extending into areas of Sub-Saharan Africa and if required beyond these boundaries.

2.2 Objectives

- To determine the core medical equipment for a medical cache for use by the Western Cape's Emergency Medical Rescue teams.
- To determine the core pharmacological agents required for a medical cache to be used by the Western Cape's Emergency Medical Rescue teams.

Chapter 3 – Literature Review

3.1 Method

While conducting a literature search on this topic, searches regarding "medical caches" were used while accessing PubMed; Medline; Mendeley; Google Scholar and Google. Search terms such as South African medical cache; South African Military medical cache; Medical cache; FEMA; USAR task forces; INSARAG and USAR medical caches were used.

3.2 Disaster Events

Disasters are unpredictable, generally devastating and are said to occur and will continue to occur because of environmental degradation, increasing resource deprivation, infectious disease and functional disruption which will ultimately overwhelm a community's ability to cope.[2,18]

Disaster incidents result in a large number of patients with a multitude of varying injuries. It is therefore necessary that the rescue team is provided with the most appropriate medical equipment and pharmacological agents to manage these injuries.

After the 2010 deployment of the South African teams to Haiti, local experts proposed that a single, all-inclusive, cross-sector, multi-disciplinary medical rescue team be developed. The aim being that personnel will be trained and equipped for response to local and if required international disasters. This was brought about because members of the South African medical team reported feelings of inadequacy as their team arrived in Haiti with limited support and communication and an inadequately suitable medical cache to be deployed with.[13,14]

3.3 Disaster Incidence

Internationally, all types of disasters are common and include hydrometeorological hazards such as earthquakes, tsunamis, floods, droughts, wind, fires, social unrest and other forms of technological disasters. The most common of these hazards are said to be floods, and windstorms, with these accounting for the greatest increase in rapid-onset natural disasters.[19]

Each year sees millions of people displaced from their homes due to disasters and conflict. It was reported by Below that of the 373 natural disasters that occurred worldwide in 2010, approximately 296 800 people had lost their lives.[20]

According to the Centre for Research on the Epidemiology of Disasters, it was reported that from 1976 – 2005 there were 0 – 999 per 100 000 victims worldwide. These were due to natural disasters in areas such as North America; northern parts of Asia as well as some northern and central parts of Africa. Areas such as South America and Southern Africa saw between 1000 – 4999 victims per 100 000 inhabitants; with Southern Asia seeing more than 4999 victims per 100 000 inhabitants (Figure 3.1).[21]

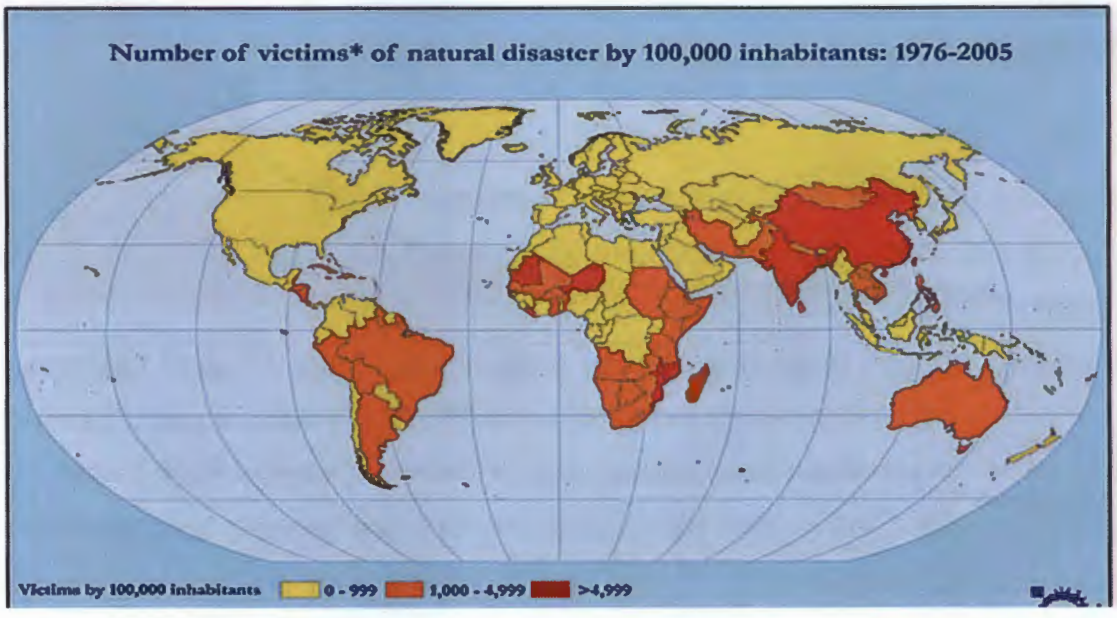
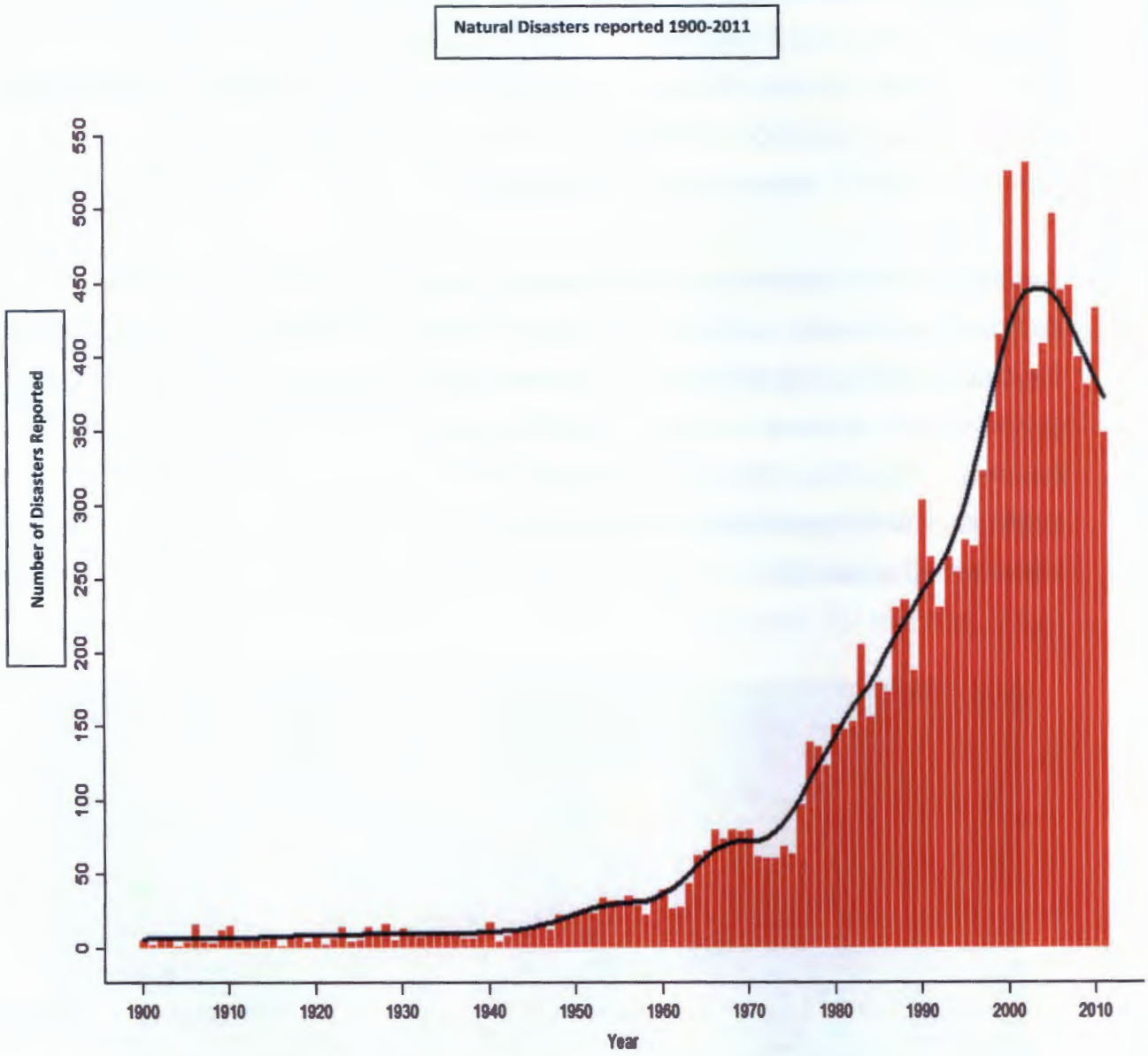
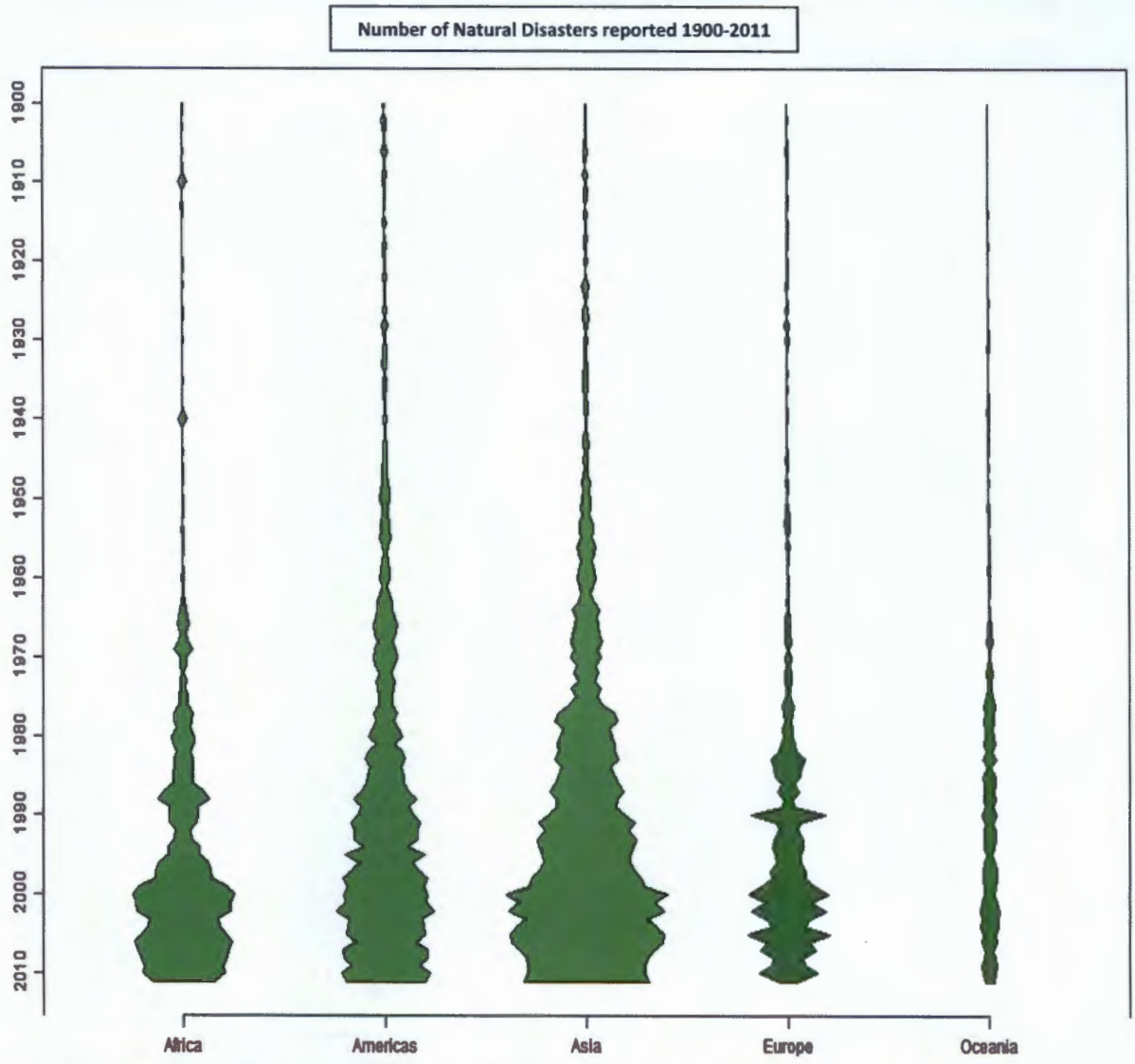


Figure3.1: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Brussels, Map 2011 [21]

During 1900 – 2011 it was found that natural disasters had escalated exponentially, these of course are just those that were reported and one can see the trend in the graph, which also shows a rise in events around the mid 1970's (Graph 3.1)[21] and also in graph 3.2 by country. Asia with the most reported natural disaster incidents then the Americas and then Africa (Graph 3.2).[21]



Graph 3.1: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]

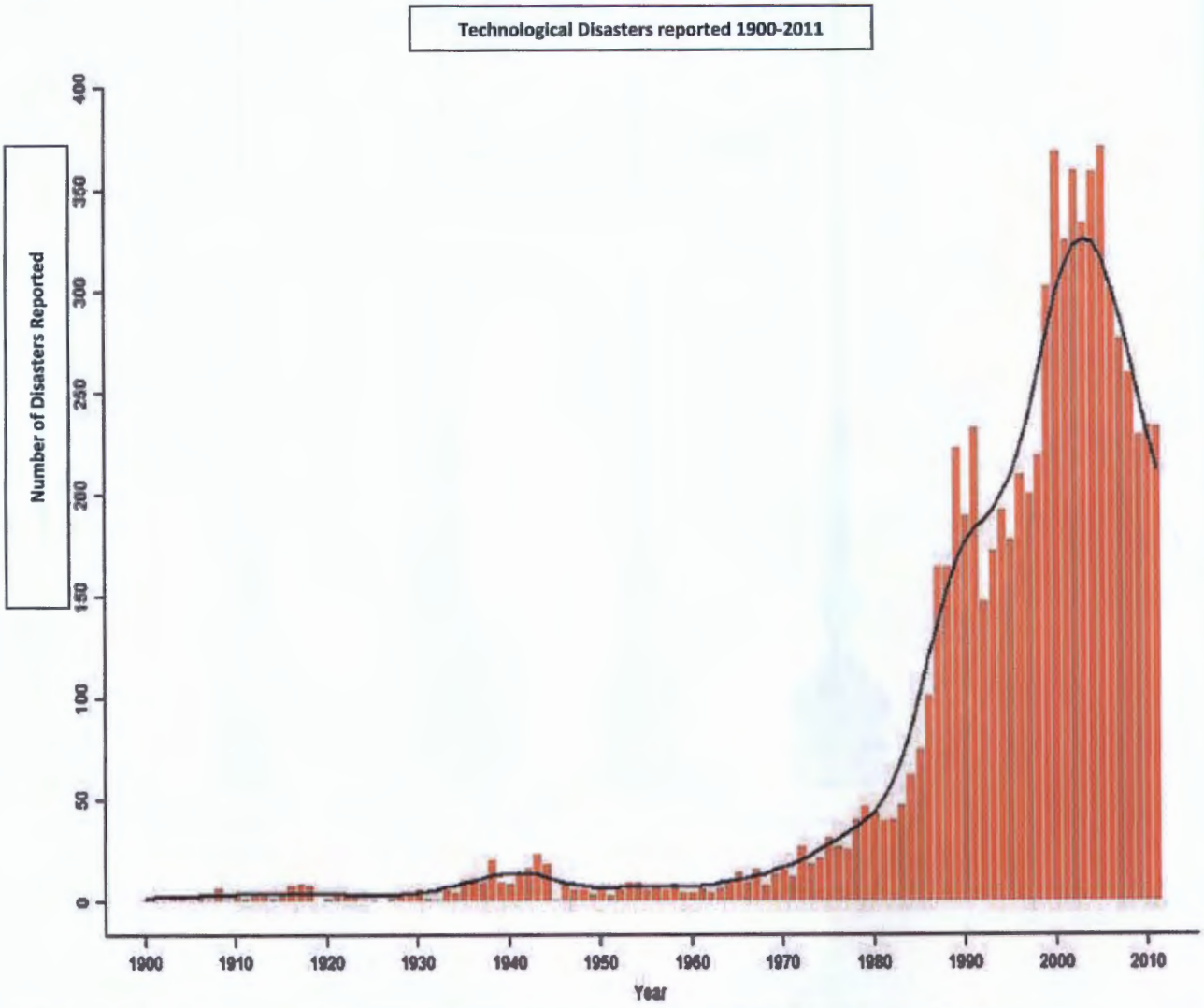


Graph 3.2: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]

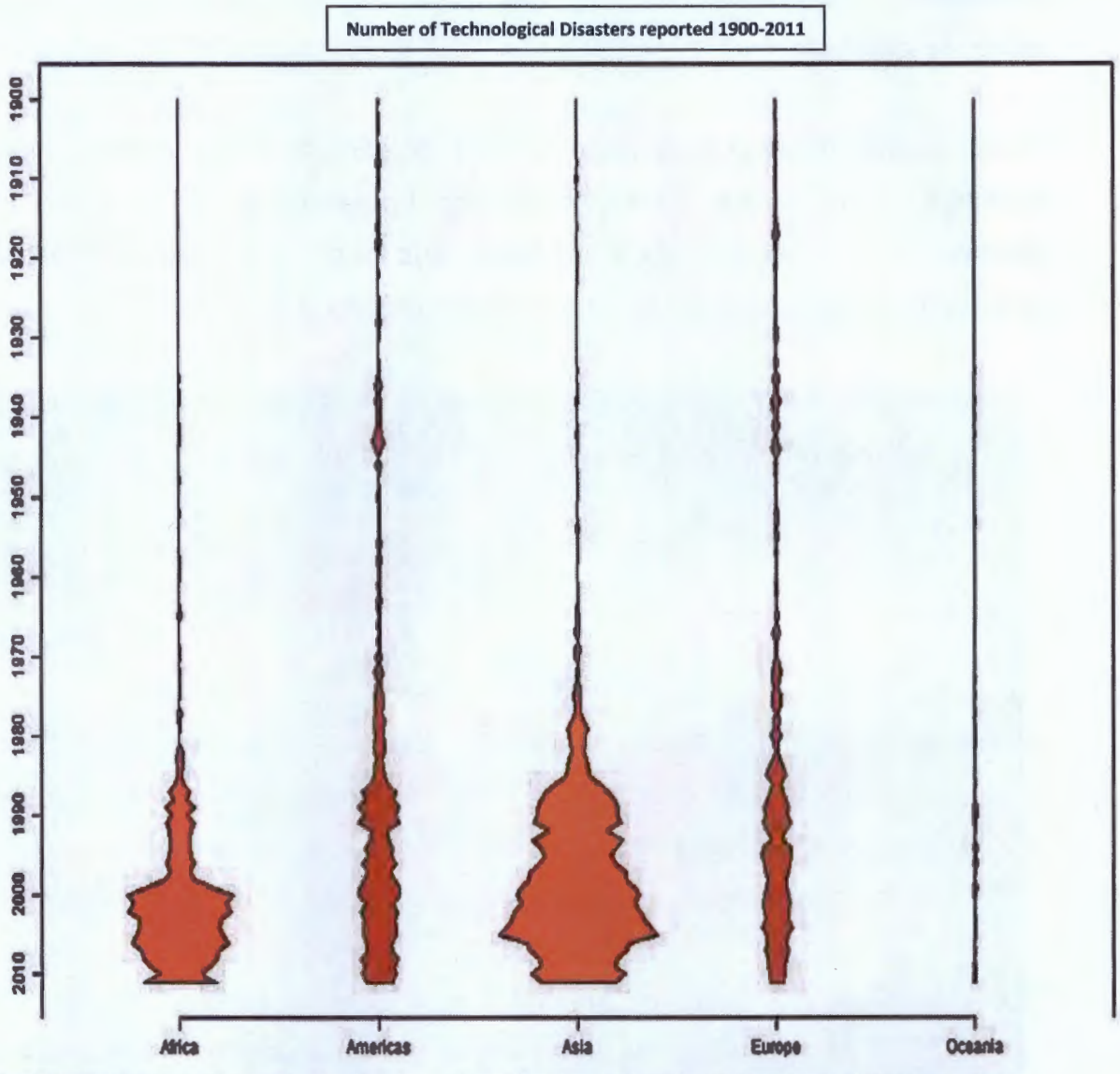
Globally in 2012 there were a reported 85 climatological disasters, 32 geophysical disasters, 150 hydrological disasters and 90 meteorological disasters; this accounted for a total of 394 occurrences according to the annual disaster statistical review. It was reported that of these countries Asia (40.6%) was most often hit, followed by America (22.1%), Europe (18.2%), Africa (16%) and Oceania (3.1%).[22]

The technological disaster trend reported that from 1900 – 2011 there had been a steep rise around the mid 1980's (Graph 3.3).[21] The number of technological disasters reported between 1900 - 2011 showed Asia and Africa as having the

highest number of incidences with the majority of disasters reportedly occurring between the late 1970's and 2010 (Graph 3.4).[21]



Graph 3.3: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]



Graph 3.4: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]

The African disaster statistics from 1980 – 2008 reported an average of 24 438 people that were killed per year.[23] The Internal Displacement Monitoring Centre (IDMC) reported that in 2012, Africa had seen a record number of 8.2 million newly displaced people; these were mainly due to flooding as well as conflict.[24]

Africa in 2012 saw an occurrence of 52.6% hydrological disasters followed by 28.1% climatological, 19.3% meteorological disasters with no reported geophysical disasters. Africa had an increase in the number of victims by 43.4% as compared to the average reported per year during 2002-2011. These were mainly due to hydrological (9.3 million victims) and climatological (28 million victims) disasters.

Both these increased exponentially from the annual average of 23.9 million and 2.1 million respectively.[22]

These events resulted in a large number of persons being affected by natural disasters. The Centre for Research and Epidemiology on Disasters (CRED) statistics of 2011 revealed Africa as having more than 100 000 person affected. This number included most of the Southern African regions (Figure 3.2).[21]

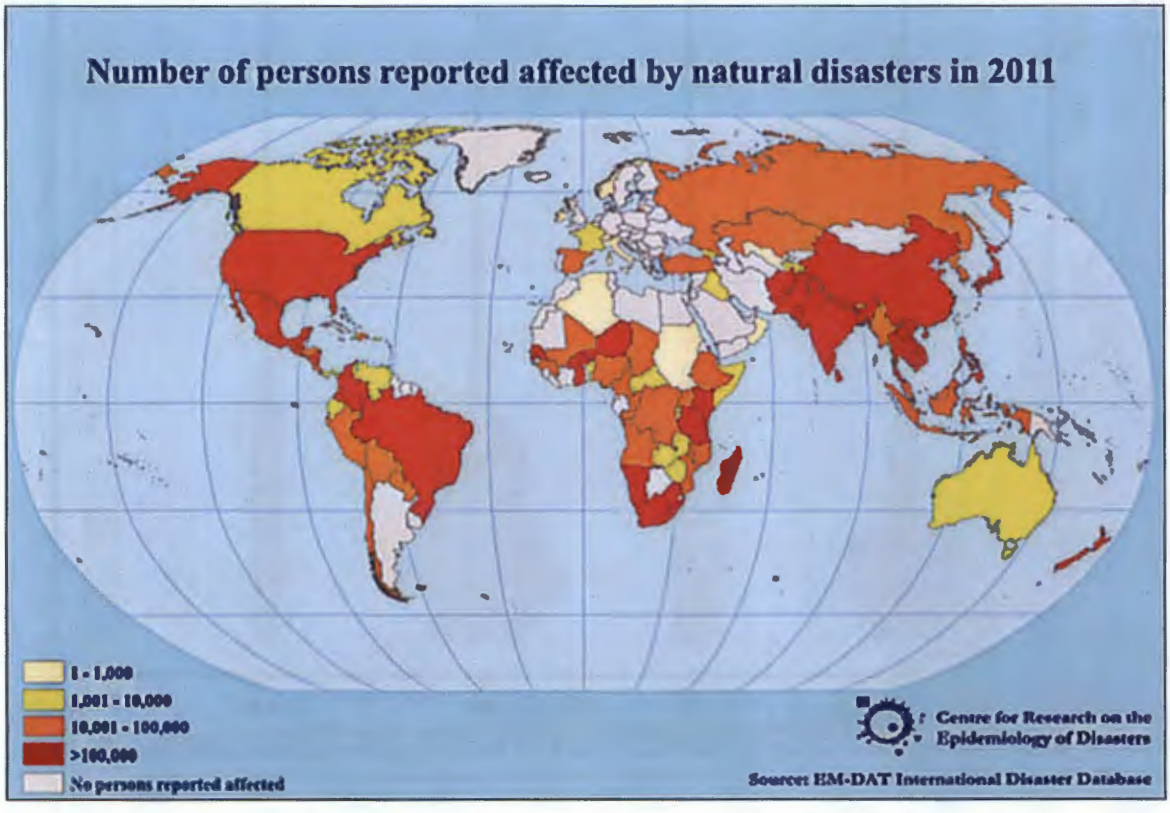


Figure 3.2: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]

The number of natural disasters by country during 1976 – 2005 saw Africa with between 0 – 119 events of which South Africa saw between 30 -119 events (Figure 3.3).[21]

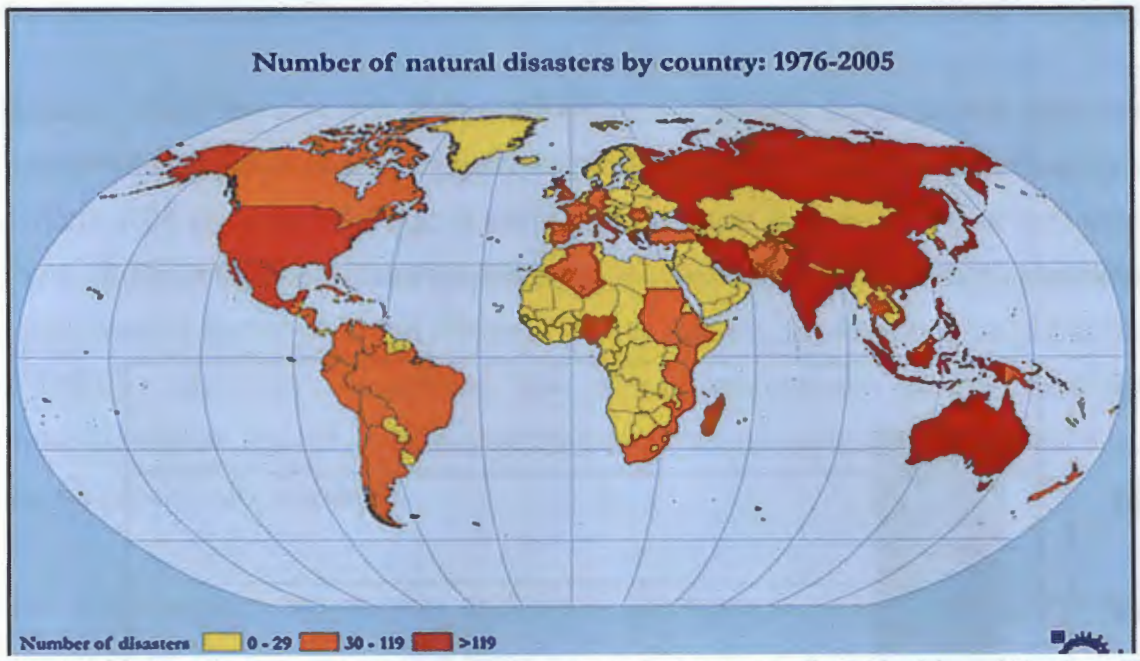


Figure 3.3: EM-DAT: The international Disaster Database. Centre for Research on the Epidemiology of Disasters - CED. Map 2011, Brussels [21]

The South African natural disaster statistics between 1980 – 2010 reported that an average of 60 people were killed per year,[25] and of the ten largest displacements in 2011, South Africa was ranked third with three events resulting in 115 532 people being displaced, of which 52 172 people were displaced due to flooding alone.[26]

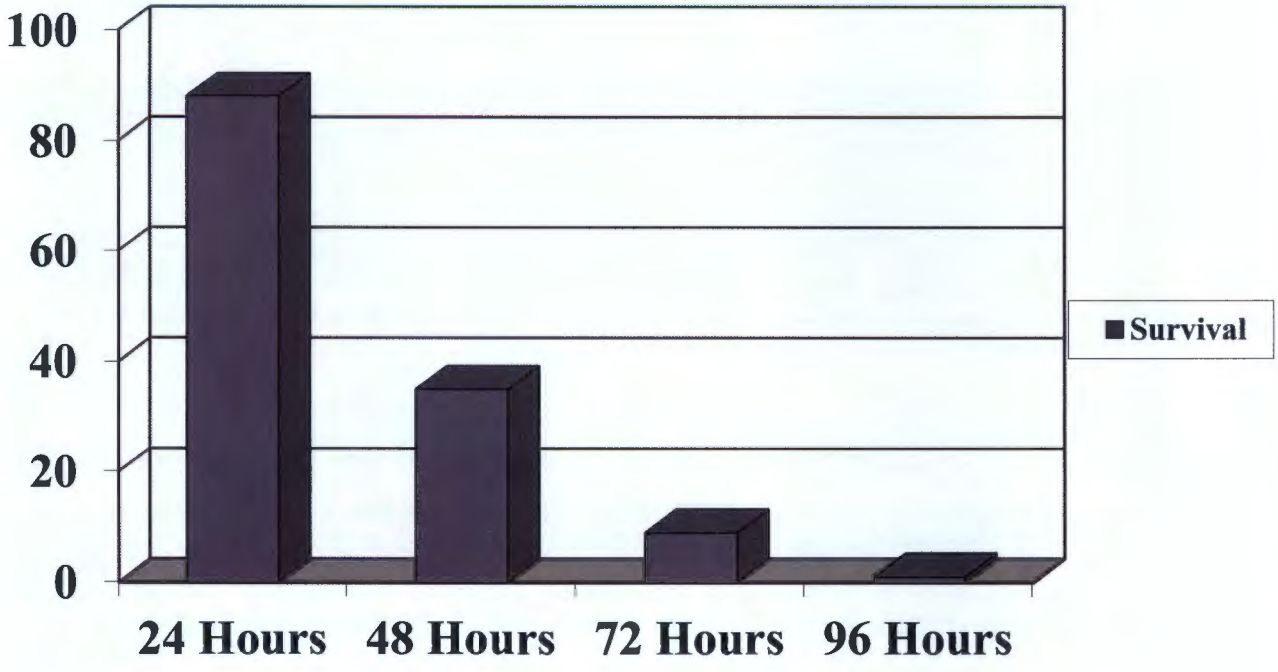
The number of windstorms reported from 1974 – 2003 in South Africa were 11 – 30[20] and the number of flood occurrences in South Africa was reportedly 16 – 60.[21]

According to the Western Cape disaster management profile conducted in 2005, it was reported that approximately 10 476 dwellings were at high risk due to disasters;[27] and that since 2005 there have been 10 declared disasters within the Western Cape alone.[27]

The Disaster Management Act of South Africa stipulates that the Provincial Government along with the five District Municipalities and the City of Cape Town have Disaster Risk Management Centres in place.[28] This is imperative as it was found that over 40% of the disasters that occurred in South Africa over the past century, occurred within the Western Cape.[29] It only seems appropriate that these Disaster Risk Management Centres be fully established.

3.4 Disaster Resilience

It has been stated in an INSARAG publication, that the survival time from the declaration of a disaster till the arrival of rescue teams decreases exponentially, and revealed that at 24 hours post disaster, that there is approximately an 85% survival rate whereas at 96 hours it drops to less than a 5% survival rate.[30] (Graph 3.3)



Graph 3.3: Survival Window Time from Disaster to Rescue. OCHA FCSS. INSARAG[30]

Other studies that were conducted on earthquakes in China and Turkey indicated that after 2 to 6 hours post entrapment, there is less than a 50% survival rate.[31]

It can therefore be deduced that in order to minimise mortality and morbidity within these disaster stricken communities, that immediate rescue and appropriate pre-hospital care be provided within the first 6 hours.[27] This means that the medical cache along with the USAR team, should ideally mobilise within 6 hours,[32,33] and to ensure this rapid response; pre-planning, preparation and funding is required.

In order to ensure that deployment is swift, it is important that this resilience is confirmed by ensuring that the necessary acts, guidelines and financial resources are secured and immediately available.

3.5 Current Medical Caches in South Africa

During the literature search it was found that presently there is only one medical cache in South Africa; this belongs to the Rescue South Africa Organisation.

There is currently no official medical cache that has been established within the governmental sector of South Africa. For this reason, an evidence based approach is being used to determine the most appropriate medical equipment, pharmacological agents and surrounding logistics necessary to establish one that can be provincially managed.

This would ensure appropriate and timely deployment by the medical and rescue personnel of the Western Cape Emergency Medical and Rescue Services who are willing and able to respond to major incidents or disasters.

3.6 Characteristics of a Medical Cache

A medical cache is a comprehensive stock pile of medical equipment and pharmacological agents.[34] The primary function of this is to provide immediate care to the members of the search and rescue team (inclusive of canines) with a secondary function of providing care to those direct victims found in the acute setting so that they may receive medical stabilisation until removal from the disaster site can be arranged.[34]

A medical cache is mainly used by the medical members of the USAR, or medical response team.[34] Thomas and Kopczak determined that a good medical cache could be achieved by including activities such as preparedness, planning, procurement, transport, storage, tracking, tracing and the procedures to be followed for clearance through customs.[35]

To ensure preparedness the medical component of a USAR team needs to be mission ready, this does not only mean the team members need to be physically and mentally prepared but that the medical cache is properly equipped and maintained for mission readiness.

INSARAG suggests that to ensure mission readiness one member of the medical team takes responsibility for the medical cache along with a logistics officer.[34] It is also suggested that the medical components be clearly categorised in a data base ensuring the maintenance and replacement of the items and that the relevant items should include expiry dates which would facilitate border crossings.[34] Storage of this cache should include easily identifiable containers, inventory lists, the weight of the cache should be stipulated on the outside of the container and a packing plan included to facilitate various medical operations.[34]

3.7 Existing Medical Caches

The literature search revealed that there are more than 80 countries worldwide[15] with varying levels of disaster response teams, some with and others without a medical cache. However the literature was fairly limited with regards to what these medical caches actually contain and even more limited was the information on how the contents of these medical caches were determined. The sections that follow take a look at some of the key medical caches that are currently found internationally, within Africa, South Africa and within the Western Cape.

3.7.1 International Medical Caches

Worldwide there are two major groups that have influenced the design of medical caches; these organisations are FEMA[15] and INSARAG[16]. Other caches that were considered include that of the USAR teams of Queensland[11], the Push Packages of the United States of America[36]; and the packing lists of the German Federal Agency for Technical Relief.[37]

3.7.1.1 Federal Emergency Management Agency - FEMA

The Federal Emergency Management Agency was established in 1979 by an executive order which combined various other disaster-related sectors into one single agency. It has been reported that as of November 2007, FEMA has already responded to over 2 700 presidentially declared disaster incidents worldwide.[38]

FEMA is a federal agency based in the United States of America (USA), which since 2003 has become part of the U.S. Department of Homeland Security. Their mission, as stated, is to "*support their citizens and first responders so as to ensure that the nation works together to build, sustain and improve their capability to prepare for, protect against, respond to, recover from and mitigate all hazards".*[15]

FEMA is built on experience and best practise from previous deployments and it is their goal to continually improve their core competencies which include service to disaster victims, integrated preparedness, operational planning and preparedness, incident management, disaster logistics, hazard mitigation, emergency communications, public disaster communications as well as continuity programs.[15,39]

FEMA's purpose is to not only ensure the rescue and support of victims of a disaster incident but to also build a culture of preparedness. FEMA refers to themselves not as a team but rather as part of a team, which includes federal partners, states, local authorities, tribal officials, the private sector, the non-profit organisations, all faith-based groups and includes members of the general public.[15]

The Task Force Equipment Cache, which is the complete cache that travels and provides support to the search and rescue teams, consists of five categories, namely medical, rescue, communications, technical support and logistics. It was designed to support a task force comprising of 80 members that are required to be self-sufficient for at least the first 72 hours of operations and a minimum of 24 hours operations for at least 14 days.[39]

The medical cache of FEMA is said to weigh almost 27 215kg and to be worth approximately $1.4 million. This medical cache includes various types of medical equipment, for example airway management sets, circulation administration sets, monitoring devices, pharmacological agents and all other relevant surgical instruments.[39]

3.7.1.2 International Search and Rescue Advisory Group - INSARAG

This agency was established in 1991 following the earthquake in Armenia in 1988[16] and is an inter-governmental network, working under the auspices of the United Nations (UN). INSARAG deals predominantly with international USAR response issues and their aim is to provide the methodology for an affected country as well as the international USAR teams responding to those countries. It aims to develop an international relationship to improve disaster response as well as improve disaster response preparedness.[16]

These guidelines are to be used by those countries wishing to establish their own USAR teams as well those that may already be established.[16] INSARAG consists of many member countries and their urban search and rescue teams. These member countries include the likes of Africa, Europe, the Middle East, the America's, Asia and the Oceania regions.[40]

Other important actions of INSARAG include the development of a legal framework, as well as policies and guidelines which are determined by the INSARAG Steering group.[34] They also ensure that information is exchanged to allow for timely and appropriate response to disaster incidents occurring worldwide.[16] Part of the essential components as per the INSARAG Guidelines is to provide emergency medical care to victims located during a rescue. Mostly it is to provide primary and emergency health care to the team members, including the canines of the USAR team.[16,34]

During disaster incidents USAR teams from the various responding countries can apply the INSARAG methodology to ensure that all members understand the roles and responsibilities in order to facilitate the integration and capacity building which would expectantly result in an efficient rescue mission.[16]

The medical equipment lists of the USAR teams include equipment for three different operational levels. These three levels refer essentially to the rescue capability of the various teams. The INSARAG Preparedness - Response document refers to these levels as light, medium and heavy operational levels. The light operational level

consists mainly of rescue tools but also includes a stocked first aid kit and a stocked emergency medical care kit (including advanced life support equipment, if members are trained to use it).[16]

3.7.1.3 Australia's Urban Search and Rescue Task Force

Australia currently deploys USAR teams from three main areas within Australia; these include New South Wales, Brisbane and Melbourne.[41] The aim of this task force is to provide search and rescue activities for those entrapped, while also being self-sufficient. The medical component is required to provide primary and emergency care to the approximately 70 task force members as well as provide immediate advanced life support to victims recovered from the rubble.[12,41]

The Australian task force currently includes the following states: New South Wales which consists of 2 complete task forces (including a medical cache), 2 USAR response teams, 1 reconnaissance vehicle and 1 medium helicopter. Victoria which houses 1 complete task force (including a medical cache) and Queensland which also houses 1 complete task force (including a medical cache). There are also the areas of the Australian Capital Territory, that of South Australia, Western Australia, Tasmania and the Northern territory that are comprised of mainly USAR teams which are still in the process of further developing their capabilities.[41]

The USAR medical equipment cache is composed of various items based on the INSARAG guidelines. These are listed under sections namely: Airway Equipment; Circulation Equipment; Monitoring Equipment; Protective and General Equipment; Dressings; Splinting / Immobilisation Equipment; Chest Drain Equipment; Procedural Disposable Equipment; Obstetric Kits and Other, which include items like gloves. Pharmacological agents include that of Antibiotics, Antiseptics and Antifungals; Respiratory Medications; Cardiac and Resuscitation Medications; Patient Comfort Medications; Analgesic Medications; Anaesthetic Medications: Eye / Ear Medications; Miscellaneous Drugs and Extras such as Fluids. Each section also includes the quantities of equipment to be deployed.[12]

3.7.1.4 Strategic National Stockpile – "Push-Packages"

The United States has a national repository of critical medical equipment and supplies which has the ability to supplement and re-supply local health authorities during the event of a national emergency.[36] This medical stock pile is maintained and quality assured and is based on the latest scientific data, threat levels and overall ability to deploy to a public health emergency situation. These strategic national stockpiles include the following supply categories: multiple 12-hour Push Packages and Managed Inventories, CHEMpacks and Federal Medical Stations.[42]

These "push-packages" are deployed once the state authorities have determined that their assistance is neccessary.[42] They are housed at undisclosed locations throughout the USA and are able to be deployed within 12 hours of a disaster being declared. They provide amongst other functions, federal medical contingency stations when local acute care systems are incapacitated.[36,42] The equipment contained in these "push-packages" weighs almost 50 tons and is comprised of broad spectrum medical items, but if specific items are required, these can be brought in within 24-36 hours of being requested.[42] Ideally the medical equipment required should be related to the type of disaster / mission that will be responded to.[36]

These push packages include pharmacological agents such as antibiotics, chemical antidotes, antitoxins, life-support medications, intravenous administrations, airway maintenance supplies and medical / surgical items.[43] These items are distributed by the states to local authorities that will then dispense them to the specific communities.[42]

3.7.1.5 Technisches Hilfswerk (THW) - German Federal Agency for Technical Relief

The German Federal Agency was founded in 1950 and is assigned to the department of the Federal Ministry of the Interior.[44] This agency is said to provide technical assistance for local and humanitarian aid when required internationally. They have previously been requested to assist in more than 100 countries for

incidents such as earthquakes, flooding and drought as well as refugee emergencies and they are capable of providing search and rescue as well as humanitarian efforts.[37]

These operations are reported to have been incorporated into the action plans of the European Union as well as that of the United Nations and are therefore able to undertake a variety of operations due to their well-established volunteer and full-time employee database.[44]

This agency's medical cache was developed on the basis of the INSARAG guidelines, as outlined by the INSARAG Medical Working Group (MWG) as well as with input from local experts in the field.[37] The equipment included in these lists is vast and ranges from technical rescue equipment to medical equipment and the size of the cache varies with the type of disaster and whether they will require a heavy or medium response team.

3.7.2 South African Medical Caches

While conducting a literature search to determine if any medical caches had been established in South Africa, it was found that the organisation Rescue South Africa was currently the only organisation with an established medical cache.[17] This organisation forms part of the UN INSARAG which is operated under the Office for the Coordination of Humanitarian Affairs (OCHA).[17]

This disaster response team is reported to be the official USAR team to the Gauteng Provincial Local Government and is made up of multi-disciplinary volunteer emergency response specialists from both the South African private and public sector.[17] These specialists provide the technical and emergency medical care to those victims in need during a disaster incident, and will respond with their cache from Gauteng.[17]

Rescue South Africa has reportedly responded to more than 14 incidents since 1999 which include disaster incidents such as earthquakes, flooding, structural collapses

and aircraft accidents. Rescue South Africa responded to an earthquake that occurred in the Marmara region in Turkey in August 1999,[17] while around the same time a tornado had ripped through the suburbs of Manenberg, Surrey Estate and Guguletu in Cape Town South Africa; which left 5 dead and 177 other people injured and many more homeless.[45,46]

While searching the literature on Rescue South Africa to identify what specific items are included in their medical cache no documentation was found. It can only be assumed that as they are part of UN INSARAG, that they follow the INSARAG guidelines on what medical equipment and pharmacological agents are recommended for inclusion into their medical cache.

3.7.3 Western Cape Medical Caches

While reviewing the literature regarding the availability of a medical cache for or within the Western Cape of South Africa, none were found.

Chapter 4 - Methods

4.1 Study Design

A three iteration modified Delphi method was used in an attempt to reach consensus on the most appropriate medical equipment and pharmacological agents that should be part of a medical cache to accompany an Emergency Medical Rescue Team in response to local and international disasters. This Delphi study was conducted over three sequential iterations which were distributed to a panel of experts over a period of ten months from the 01 June 2012 – 30 April 2013. The characteristics of this method included anonymity as well as the overall statistical feedback of results from previous iterations.

In determining the items for inclusion into this medical cache; the organisations of FEMA and INSARAG were referred to as they are the two main organisations used by the majority of USAR organisations in setting up the foundations for medical caches. Along with these established lists, the equipment that is currently available to EMS within the Western Cape and the pharmacological agents as set according to the HPCSA ALS protocols was also incorporated.

After ethical approval was gained, the first survey was distributed via an internet based survey software and questionnaire tool. At this stage potential participants were informed that by completing the questionnaire they were voluntarily consenting to participate in this study. The same questionnaire was distributed to each of the participating experts irrespective of their qualifications. As anonymity was considered paramount in this inter-professional expert group, everyone was prompted at set intervals to complete the study. Only the overall collated results were sent out to individuals between iterations. In this way anonymity was still ensured as only the primary researcher had access to the participant list.

Iteration 1 consisted of 2 categories, Medical Equipment and Pharmacological Agents; with iterations 2 and 3 being divided into seven categories namely Airway, Breathing, Circulation, Immobilisation, Diagnostics, Other and Pharmacological Agents. Iteration 1 simply split the medical equipment from the pharmacological

agents while iterations 2 and 3 were split into specific categories based on what may be considered the fundamentals of pre-hospital emergency treatment priority areas. These categories were set out as such to also facilitate the participants in grouping the various items together, making assessment easier. These items in the various categories were then considered according to a 5-point Likert scale. The Likert scale included categories of strongly disagree, disagree, neutral, agree and strongly agree.

The consensus level of agreement was set at 85%. While this may be considered as high for a consensus process[47], the researchers felt that this would be achieved given the clear guidance offered and familiarity of the experts with the complexities inherent in the process. The second and third iteration was based on the non-agreements; those items of medical equipment or pharmacological agents that had less than 85% consensus. Those items that did not achieve consensus across all three iterations were therefore not included in the final medical cache.

These questionnaires were conducted in English and each expert was requested to mark off the medical equipment and pharmacological agents from a structured list according to what they felt were more or less important. Examples of the 3 iterations of questionnaires can be found under appendices A, B and C.

The first iteration of the study involved the distribution of a collated list of possible contents of a medical cache which were obtained from the guidelines of FEMA, INSARAG, the USAR Medical Cache No. 2 of Queensland Emergency Services,[12] as well as what is currently available to the emergency medical practitioners in the Western Cape. The concept was to include various mainstream hard medical equipment and pharmacological agents, as is found among the more established guidelines of FEMA and INSARAG, and develop a questionnaire for experts to assess and choose what they believe important to be included in a USAR medical cache.

Each of the questionnaires included a comments section as well so that participants could add any suggestions regarding any other medical equipment or pharmacological agents they felt would be suited to the medical cache.

Iteration 1 was analysed and iteration 2 developed based on the extrapolated results and these were then built into an excel spread sheet. In the second questionnaire contents were grouped together in the seven sections as stated above. Under each of these sections lists of medical equipment and pharmacological agents were developed of which, as previously stated, the participants had to assess via a Likert scale. This same process was followed for iteration 3 as well.

Once all iterations were completed, they were analysed firstly by assessing which items had achieved 100% consensus and then assessing which items had achieved above 85% consensus. The Strongly Agree and Agree results were combined and then labelled with the heading Agree. The percentage agreements listed under the Disagree group and those listed under the Strongly Disagree group were combined and labelled with the heading Disagree. The neutral group remained unchanged.

Results of these can be found on appendices D, E and F.

4.2 Study Sample

Selected experts (n=30) with the relevant experience in the disciplines of disaster medicine, emergency medicine and pre-hospital emergency medicine were invited to participate in this study. These experts included that of local, national and international persons who had been personally involved in previous deployments and in the design of a medical cache for the purpose of urban search and rescue. These persons had to have been current within the field of disaster medicine and emergency medicine. These experts were identified through the pre-hospital and disaster management network and recommendations on other participants from those persons were also identified.

Of the 30 participants, 12 participants were local and 18 were international participants; 22 were doctors and the other 8 participants were a mix of pre-hospital practitioners, which included ALS as well as ILS practitioners with previous experience in USAR deployment.

4.2.1 Inclusion into Study

- Participants working in the field of disaster medicine (doctors and pre-hospital practitioners) with experience in policy making or in the development of rescue guidelines regarding deployment of a medical cache.
- Those that were not involved with the designing or packing of a medical cache but were deployed with and used a medical cache were also included in the study.

4.2.2 Exclusion from Study

- Emergency practitioners that may have responded to disasters or major incidents but played no role in the direct or indirect provision of medical care were excluded from the study.
- Those that were involved in either the packing or design of a medical cache but were not deployed on the respective mission were excluded from the study.

4.3 Institutional Ethics Approval

In this study Ethical approval was obtained from the University of Cape Town (UCT) Faculty of Health Sciences Human Research Ethics Committee (HREC Ref: 241 / 2012).

4.4 Data Collection and Management

The primary researcher alone held access to the participant list which was secured along with the data collected. Data was collected after each iteration and was analysed by the primary researcher. The collected data was transferred onto an electronic data sheet (Microsoft excel®, version 14.0.6029.1000, Microsoft Corporation, Redmond, WA). These spread sheets were password protected to ensure the integrity of the data, this data was then stored on an external USB device and stored in a safe. The data collected was only made available to the primary researcher and the supervisors of the study if required.

Chapter 5 – Results

5.1 Iteration 1

This iteration was distributed to 30 participants and saw a return of 15 responses.

5.1.1 Equipment

Consensus was reached on 25 of the 38 medical equipment items and 23 of the 28 pharmacological agents.

The results from iteration 1 are described below. Each of the results is specified under the seven respective headings and is represented by the subsequent graphs.

Absolute consensus is regarded as those items with 100% consensus. Each category is represented by a graph and each of the three consensus columns (Agree, Neutral and Disagree) is indicated by a different pattern.

5.1.1.1 Airway

This category consisted of 5 items (laryngoscope; Magill's forceps; oesophageal detector device (EDD); suction device and a cricothyroidotomy kit. Iteration 1 saw the laryngoscope (93%), Magill's forceps (86%), suction device (100%) and the cricothyroidotomy kit (93%) achieving consensus. The EDD (57%) did not achieve consensus in this iteration. This can be seen in the following diagram.

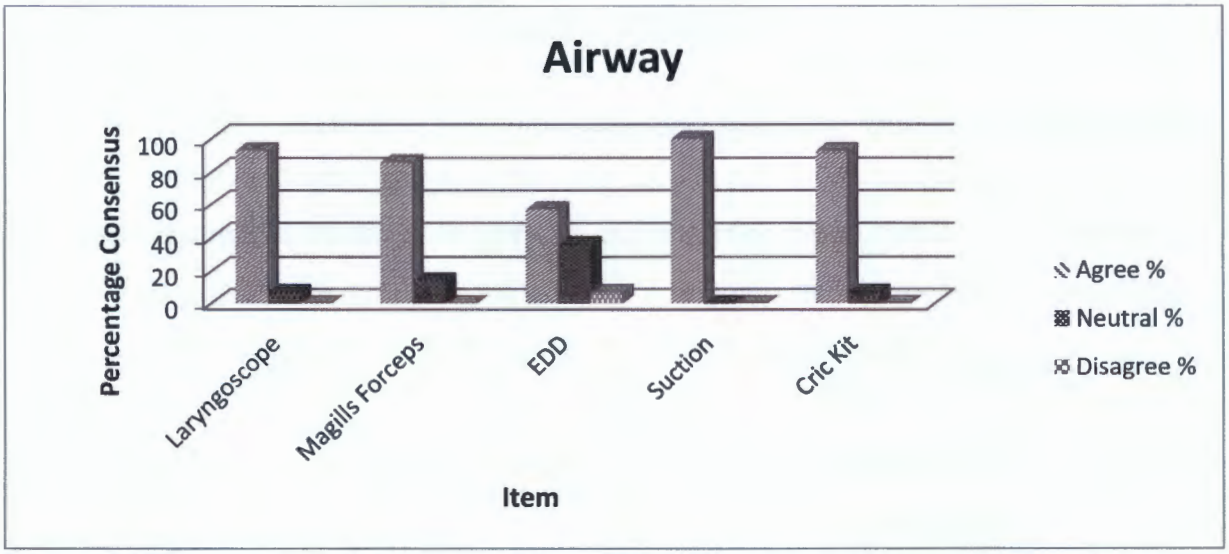


Figure 5.1: Percentage of consensus for each item in the Airway category of iteration 1.

5.1.1.2 Breathing

This category also consisted of 5 items which included a bag-valve mask (BVM); a Positive End-Expiratory Pressure (PEEP) valve; mechanical ventilator; capnograph and portable capnometer. The BVM (100%), mechanical ventilator (93%) and capnograph (93%) achieved consensus in iteration 1. The PEEP valve (64%) and the portable capnometer (71%) did not achieve consensus in this iteration. This is reflected in the graph below.

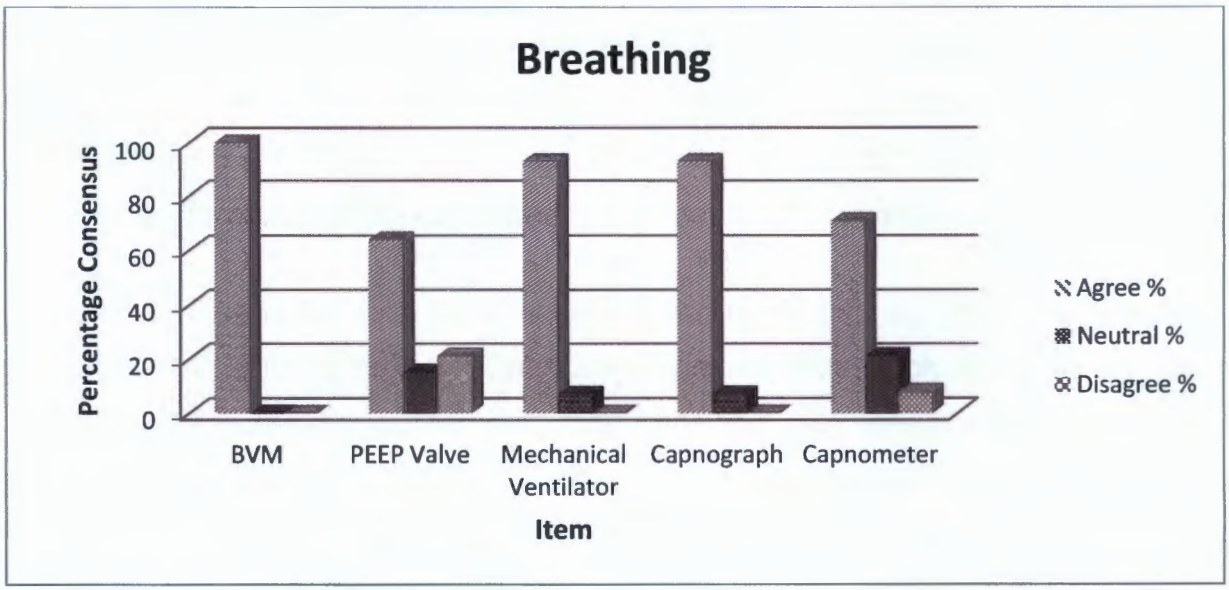


Figure 5.2: Percentage consensus for each item in the Breathing category of iteration 1.

5.1.1.3 Circulation

This category consisted of 3 main items, namely the electrocardiograms (ECG); the syringe driver and the tourniquets. The ECG's / monitors included the likes of an AED, a 3 lead ECG and a 12 lead ECG. Iteration 1 saw the consensus of the tourniquets (92%) alone. The AED (64%), 3 lead ECG (77%) and 12 lead ECG (72%), along with the syringe driver (54%) did not achieve consensus in this iteration. This is seen in the following graph.

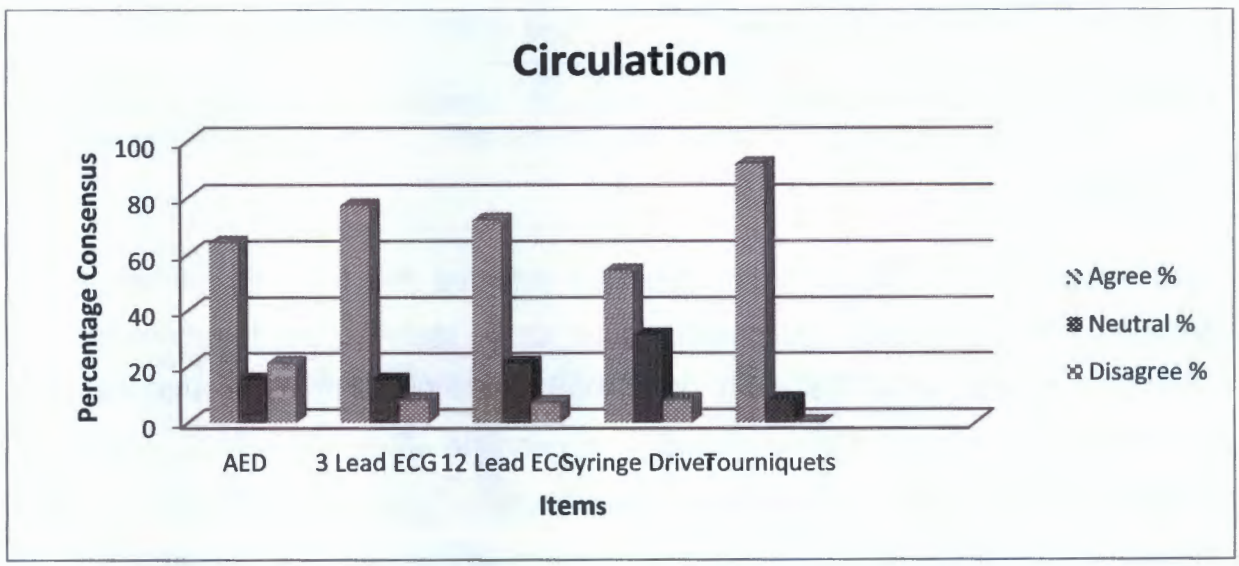


Figure 5.3: Percentage consensus for each item in the Circulation category of iteration 1.

5.1.1.4 Immobilization

Six items were listed under this category. These included the scoop stretcher; the long spine board; the spider harness; the head blocks with base plates, the Kendrick Extrication Device (KED) and the Stokes basket. Absolute consensus was reached with only 1 item here, the scoop stretcher (100%); while the long spine board (93%) and the spider harness (93%) achieved above 85% consensus. The head blocks with base plate (79%), KED (50%) and the Stokes basket (64%) did not achieve consensus. This is shown in the following graph.

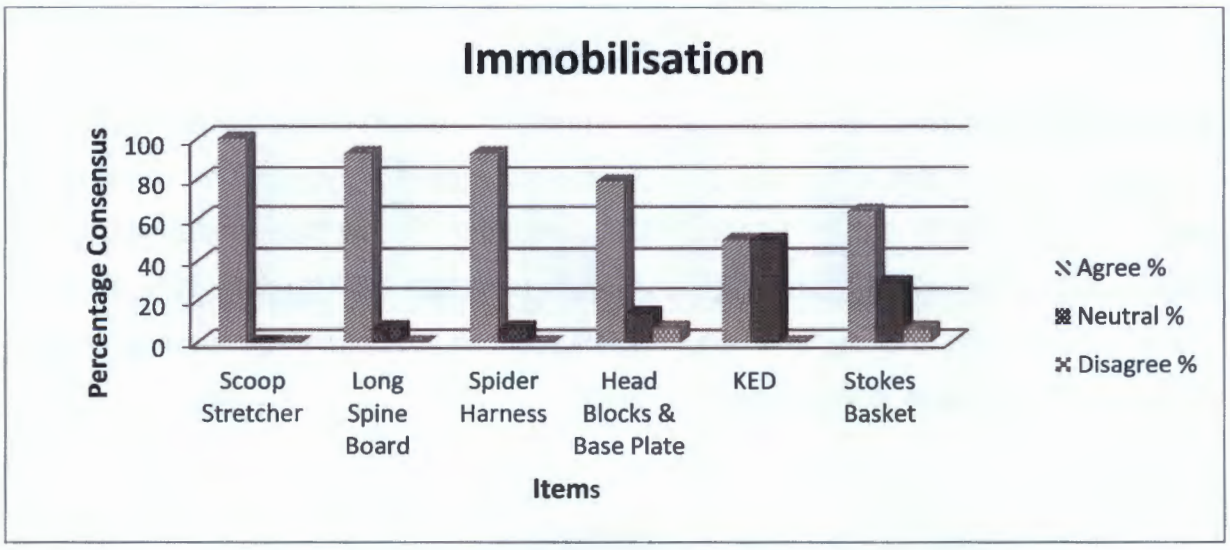


Figure 5.4: Percentage consensus of each item in the Immobilisation category of iteration 1.

5.1.1.5 Diagnostics

This category consisted of 8 items, which included the following pieces: blood pressure cuffs (all sizes); glucometer; pupil torch; stethoscope; thermometer; the vital signs monitor; an arterial blood gas (ABG) machine and an ultrasound machine. The following items achieved absolute consensus after iteration 1: the blood pressure cuffs (all sizes) (100%); glucometer (100%); pupil torch (100%), stethoscope (100%), along with the thermometer (86%) and the vital signs monitor (86%) which achieved above 85% consensus. The ABG machine (36%) and the ultrasound machine (57%) did not achieve consensus in this iteration.

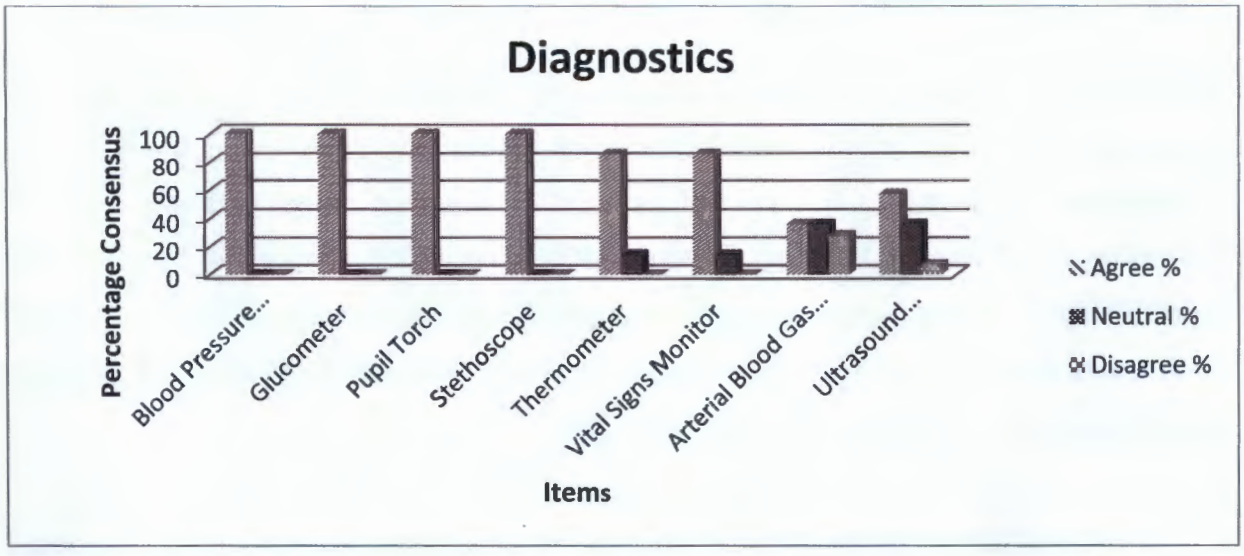


Figure 5.5: Percentage consensus of each item in Diagnostics category of iteration 1.

5.1.1.6 Other

This category consisted of the following various items: an emergency advanced life-support (ALS) drug bag; rescue scissors; blankets; drug box for emergency and chronic medications; an advanced life-support jumpbag; refrigeration / cold storage means; sharps containers; triage tags and pacing pads. Items which achieved absolute consensus after iteration 1 included that of the emergency ALS drug bag (100%), and rescue scissors (100%), while those with consensus above 85% included blankets (93%), the ALS jump bag (93%), refrigeration / cold storage (86%), sharps containers (93%) and triage tags (86%). The drug box (83%) for emergency and chronic medications along with the pacing pads (57%) did not achieve consensus with this iteration. The results can be seen in the graph below.

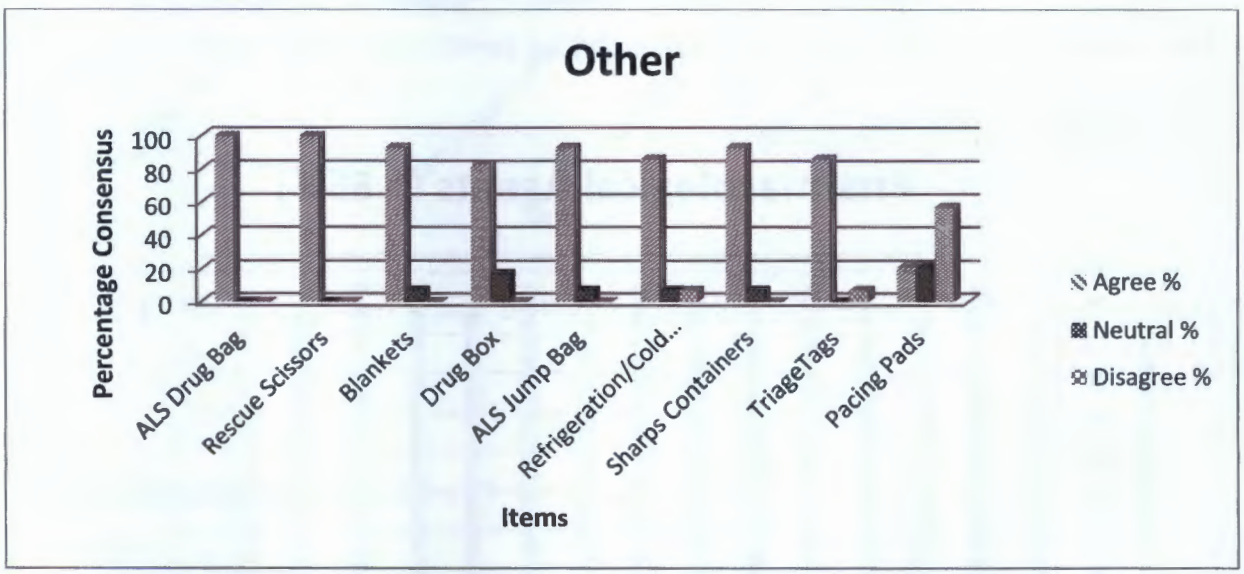


Figure 5.6: Percentage consensus for each item of the Other category in iteration 1.

5.1.2 Pharmacological Agents

The following pharmacological agents were included in iteration 1: antibiotics; analgesics; anti-inflammatory agents (Ibuprofen); anti-emetics; antacids; antiseptics; Adrenaline; Atropine; Amiodarone; Aspirin; Beta 2 stimulants; Calcium chloride; Diazepam, Dextrose 50% solution; Furosemide; Hydrocortisone; intravenous fluids; Ipratropium bromide; Midazolam; Glycerol Trinitrate (nitrolingual spray); Paracetamol; Promethazine; Sodium bicarbonate; various induction agents

(Etomidate and Ketamine); various paralytic agents (Suxamethonium, Rocuronium and Vecuronium) as well as thrombolytic agents.

Agreement was achieved with the majority of medications in iteration 1 with the following pharmacological agents achieving absolute consensus (100%): broad spectrum antibiotics; analgesics; antiseptics; Aspirin; intravenous fluids; Paracetamol and the induction agent Ketamine.

Those pharmacological agents that achieved above 85% consensus included the following: anti-inflammatory agents (86%), anti-emetics (93%), antacids (86%), Adrenaline (93%), Atropine (93%), Amiodarone (86%), Beta 2 stimulants (93%), Diazepam (93%), Dextrose 50% (93%), Furosemide (93%), Ipratropium bromide (86%), Midazolam (93%), Sodium bicarbonate (93%), Suxamethonium (86%) and Rocuronium / Vecuronium (86%). These can be seen in the graph below.

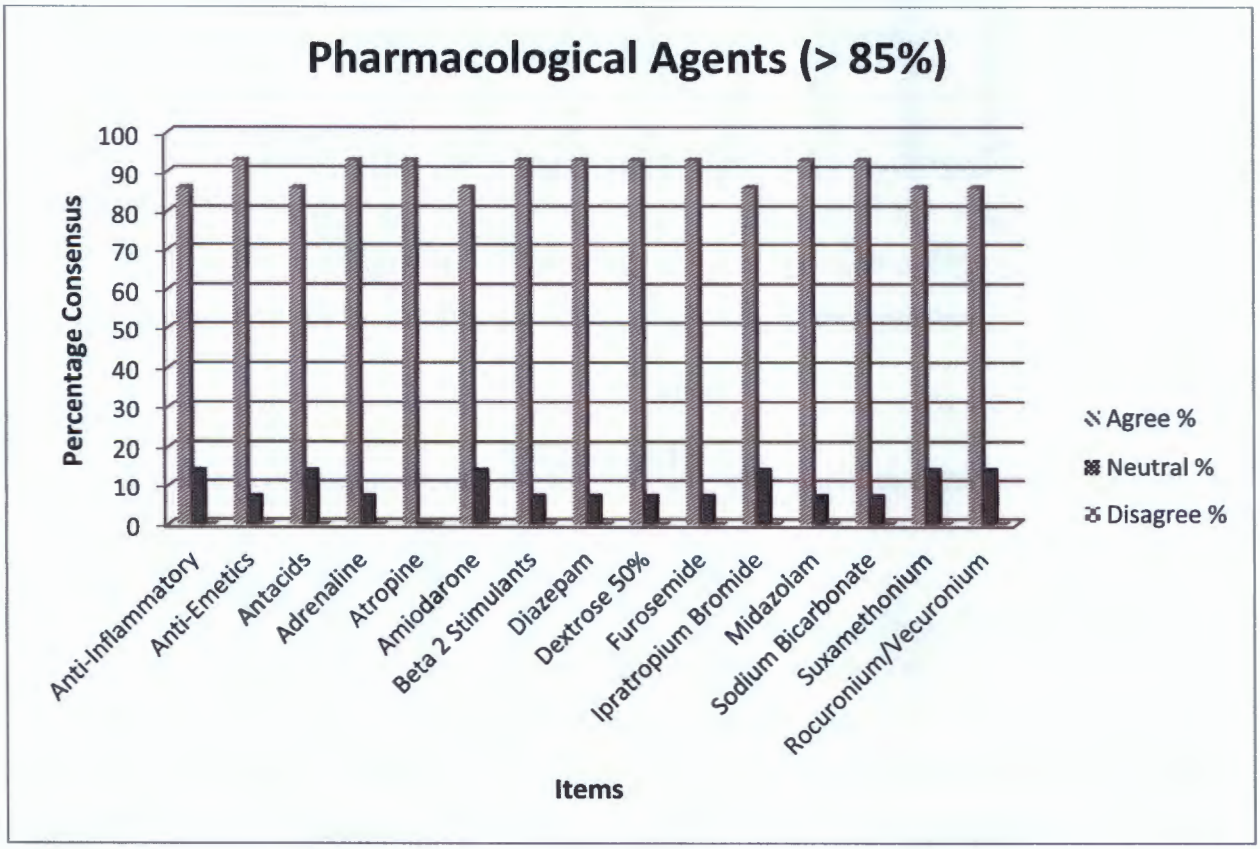


Figure 5.7: Percentage of Pharmacological agents with >85% consensus in iteration 1.

Pharmacological agents were no consensus was achieved after iteration 1 included that of Calcium chloride (80%), Hydrocortisone (79%), Glycerol Trinitrate (nitrolingual spray) (72%), Promethazine (79%) and Thrombolytic agents (29%). This can be observed in the following graph.

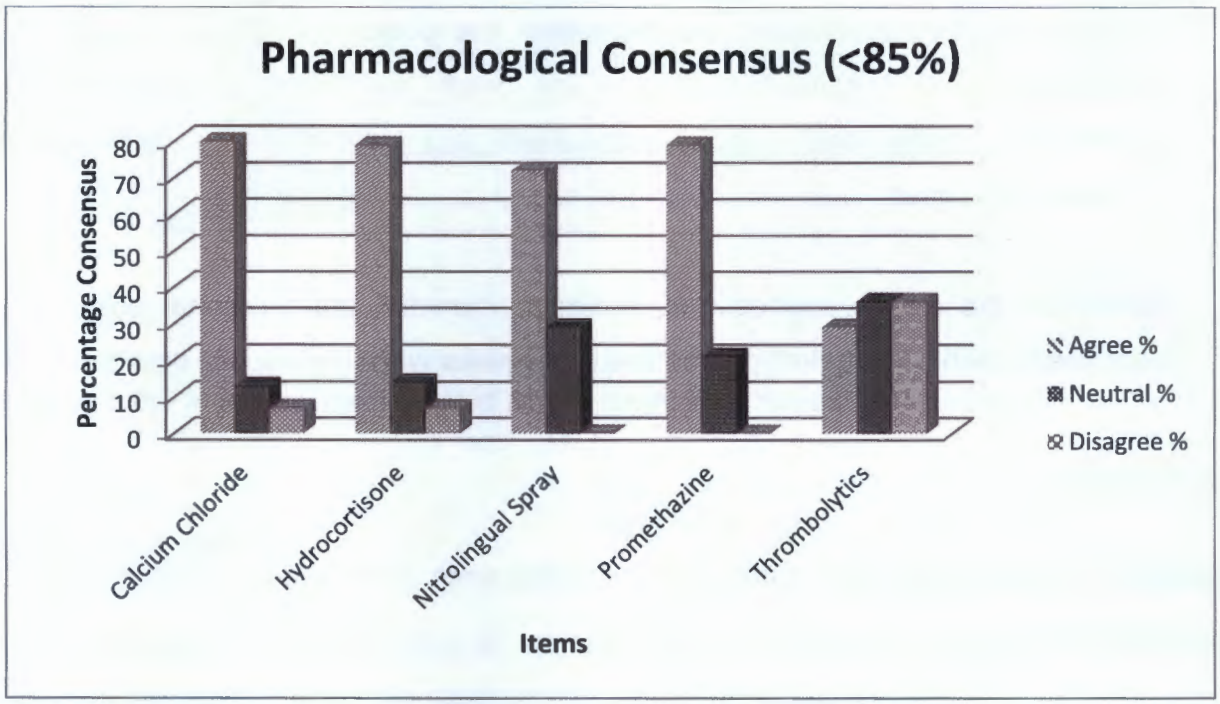


Figure 5.8: Percentage consensus of Pharmacological agents with <85% agreement in iteration 1.

5.1.3 Comments from Iteration 1

Comments were made during this iteration and were incorporated into the second iteration list of medical equipment and pharmacological agents.

Some of these comments included the following suggestions aimed at inclusion into the questionnaire:

- Potential confusion over having an ALS ECG / monitor with capnography as well as a portable capnometer. It was suggested by the participants that it may be best that at least two multi-purpose devices be included in order to save space.

- Fentanyl or Alfentanyl to be used instead of morphine due to the pharmacokinetics involved.
- A participant suggested that the following items were missing from the generated list, these items included a satellite phone, passports, visas, money in small denomination notes, on site portable radios simplex and duplex, off-site radio communications and repeaters and power sources or generators. Mannitol and sodium bicarbonate for crush syndrome management or personal safety and support equipment e.g. water bottles and water purification gear.

Based on the above suggestions, fentanyl, mannitol and personal protective equipment such as goggles, gloves and facemasks were included in iteration 2.

5.2 Iteration 2

Iteration 2 was again distributed to the participants (n=30) with a return of 12 questionnaires.

5.2.1 Equipment

The results from iteration 2 were as follows and again will be reported under the respective headings and corresponding graph.

5.2.1.1 Airway

Only one item was included here; the oesophageal detector device (EDD) (64%), which again showed no consensus.

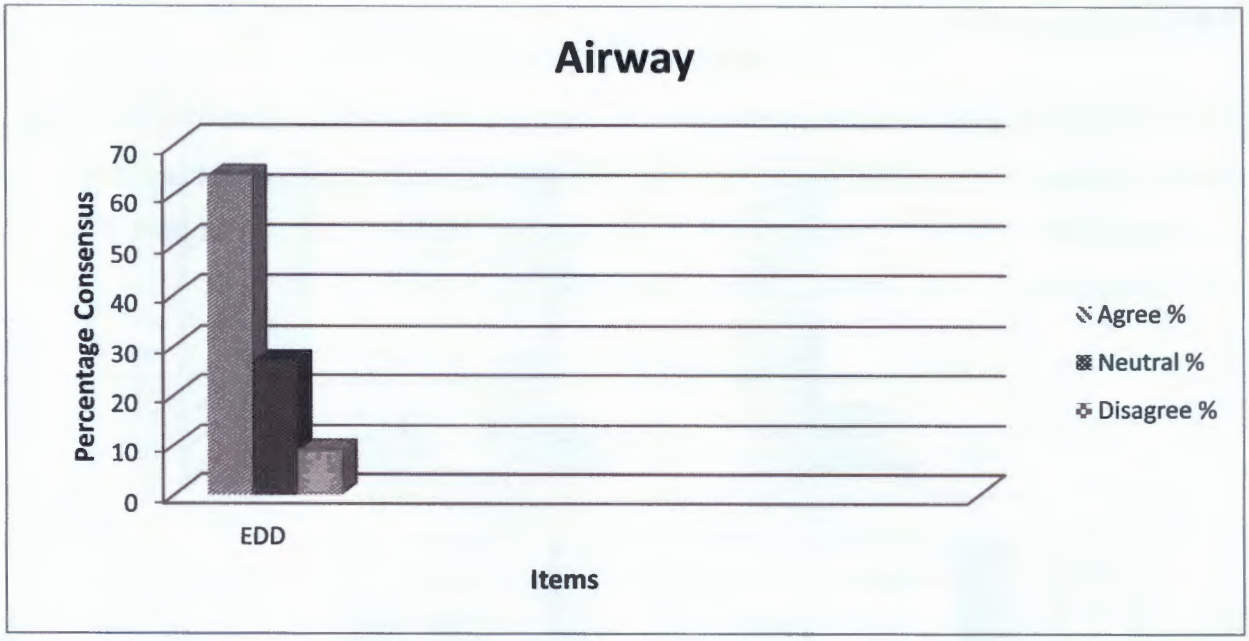


Figure 5.9: Percentage consensus of item in the Airway category of iteration 2.

5.2.1.2 Breathing

This category included 2 items, namely the PEEP valve (64%) and portable capnometer (82%), which showed no consensus after iteration 2.

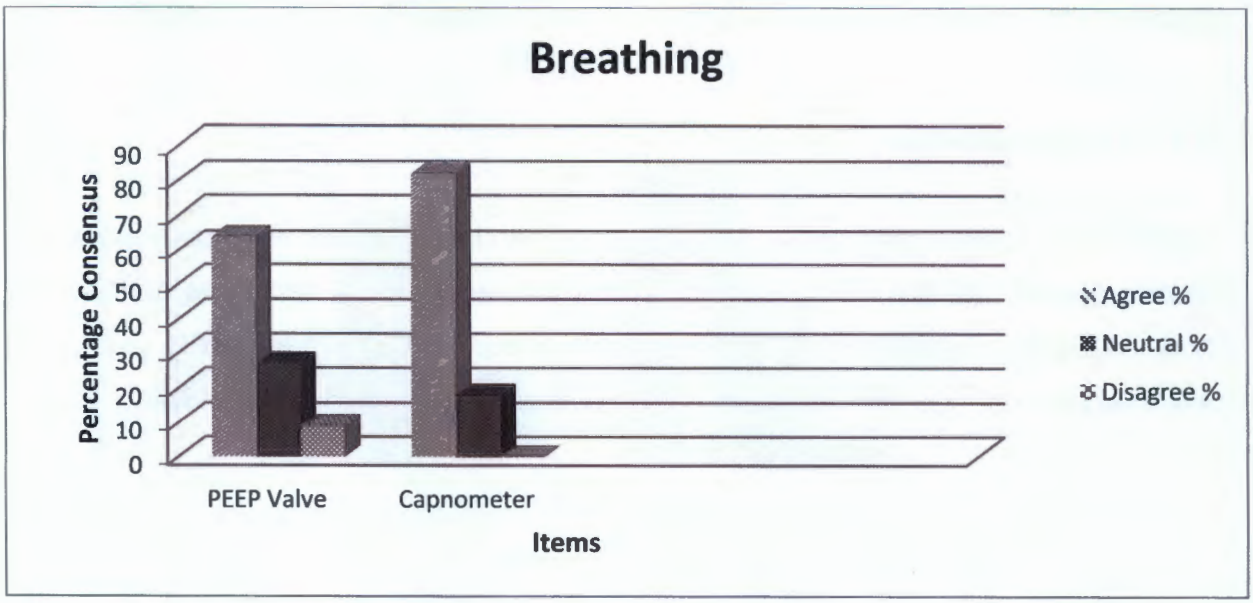


Figure 5.10: Percentage consensus of each item in the Breathing category of iteration 2.

5.2.1.3 Circulation

In this category the electrocardiograms / monitors [AED (82%), 3 lead ECG (64%) and 12 lead ECG (82%)] were included along with the electric or battery operated syringe driver (64%). These devices again did not achieve consensus post iteration 2. These results are shown in the graph below.

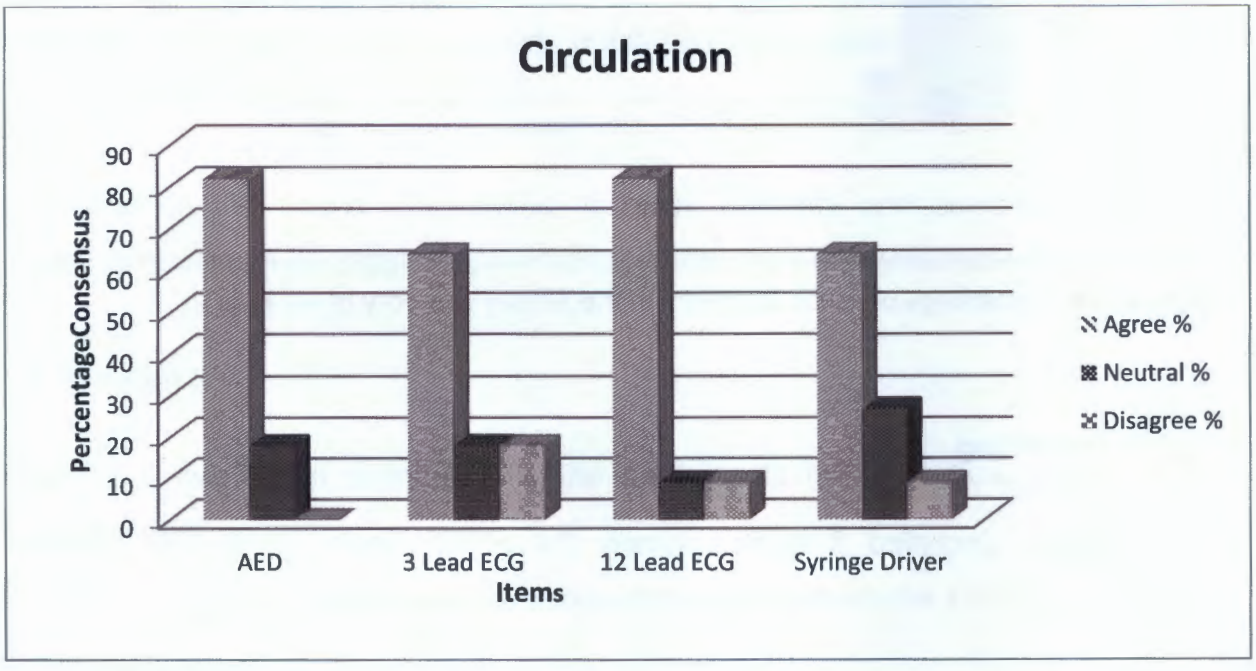


Figure 5.11: Percentage consensus of items in the Circulation category of iteration 2.

5.2.1.4 Immobilization

There were 3 items included in this category; the head blocks with base plate, the Stokes basket and the KED. Of these items the head blocks with base plate (91%) and the Stokes basket (91%) achieved consensus, which left the KED (82%) not achieving consensus after iteration 2. These results are seen in the following graph.

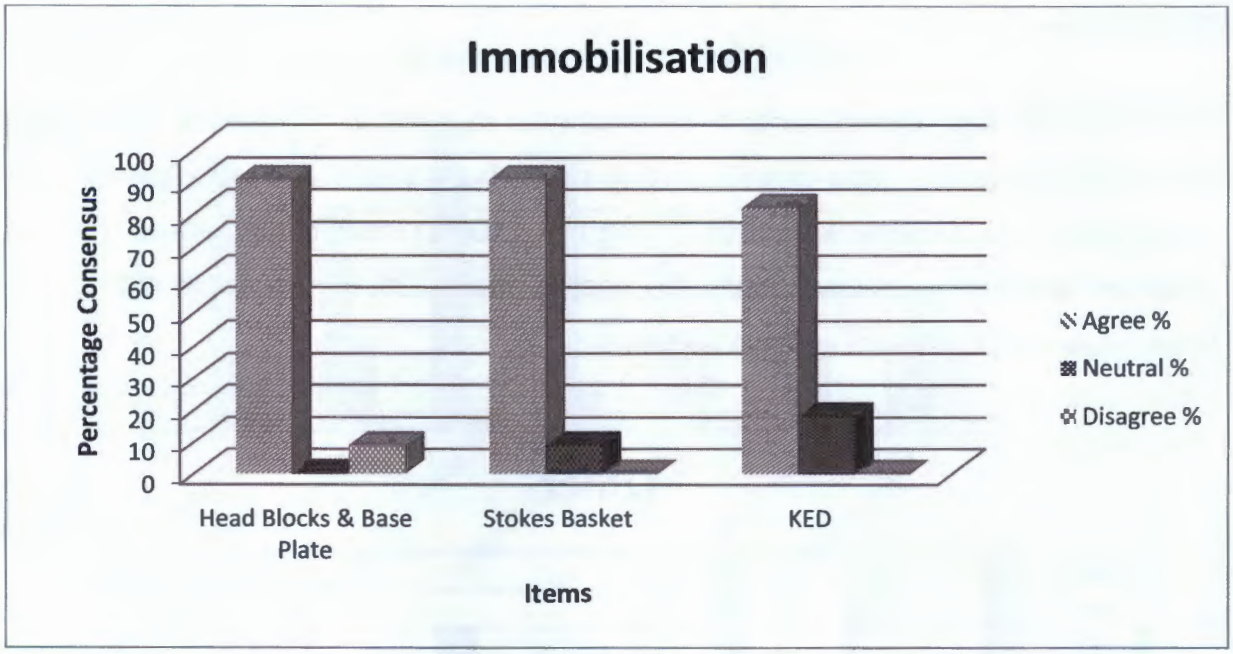


Figure 5.12: Percentage consensus of items of the Immobilisation category of iteration 2.

5.2.1.5 Diagnostics

Iteration 2 included the ABG machine (27%) and Ultrasound machine (64%) and again no consensus was reached.

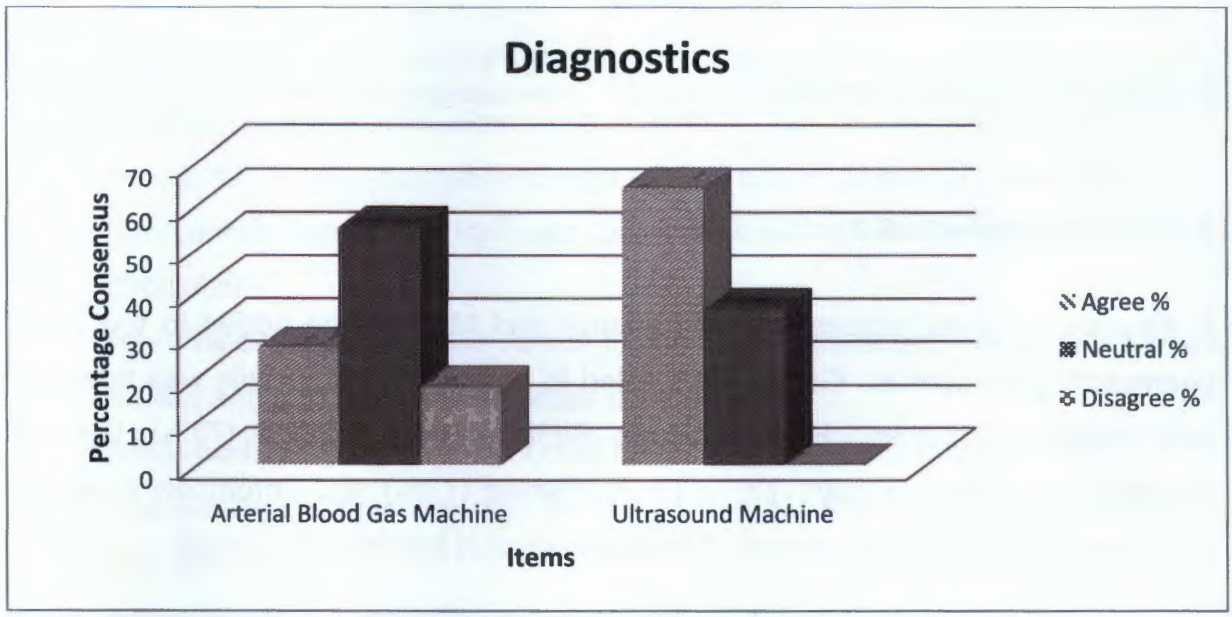


Figure 5.13: Percentage consensus of items in Diagnostic category of iteration 2.

5.2.1.6 Other

Six items were considered under this category in iteration 2. These items included facemasks, goggles, nitrile gloves, pacing pads, burn shield and latex gloves. Of these items the facemasks (100%), goggles (100%) and nitrile gloves (100%) achieved absolute consensus while the pacing pads (73%), burn shield (82%) and latex gloves (64%) did not achieve consensus.

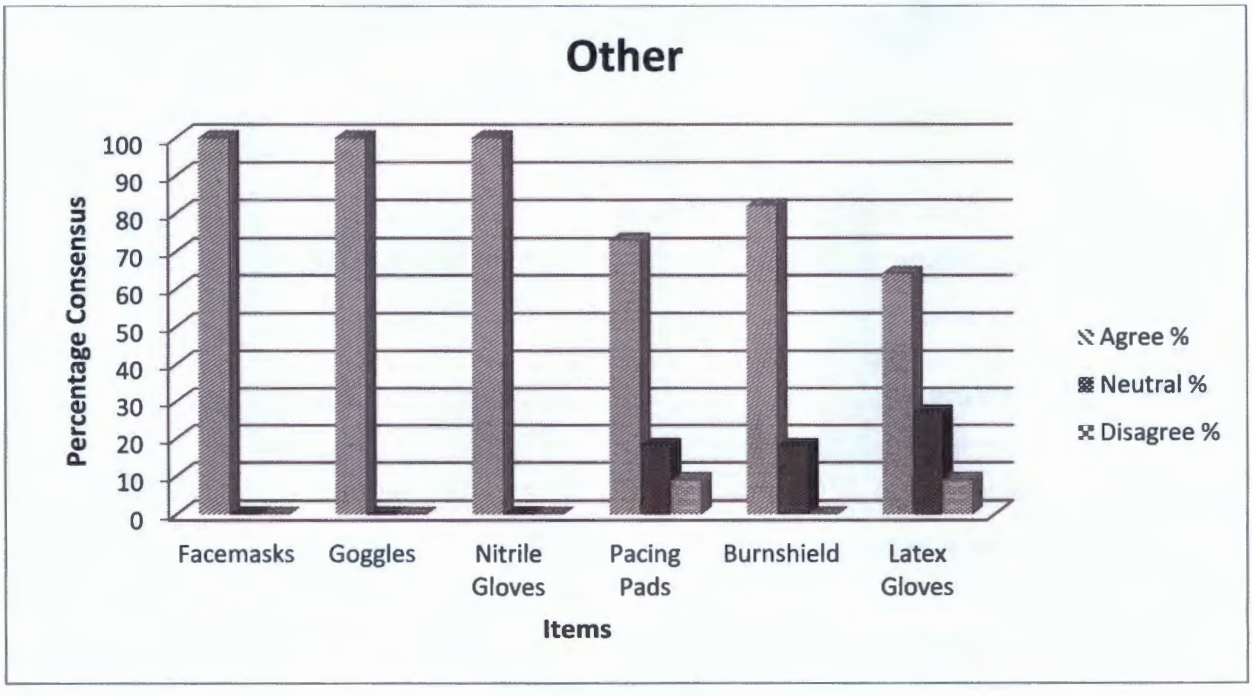


Figure 5.14: Percentage consensus of items in Other category of iteration 2.

5.2.2 Pharmacological Agents

In iteration 2 it was suggested that Fentanyl and Mannitol be added to the list of pharmacological agents. Of the items listed in Iteration 2, consensus was achieved with Fentanyl (91%) and Hydrocortisone (91%). While Mannitol (73%), Glycerol Trinitrate (nitrolingual spray) (73%), Promethazine (73%) and Thrombolytic agents (27%) did not achieve agreement. This is reflected in the following graph.

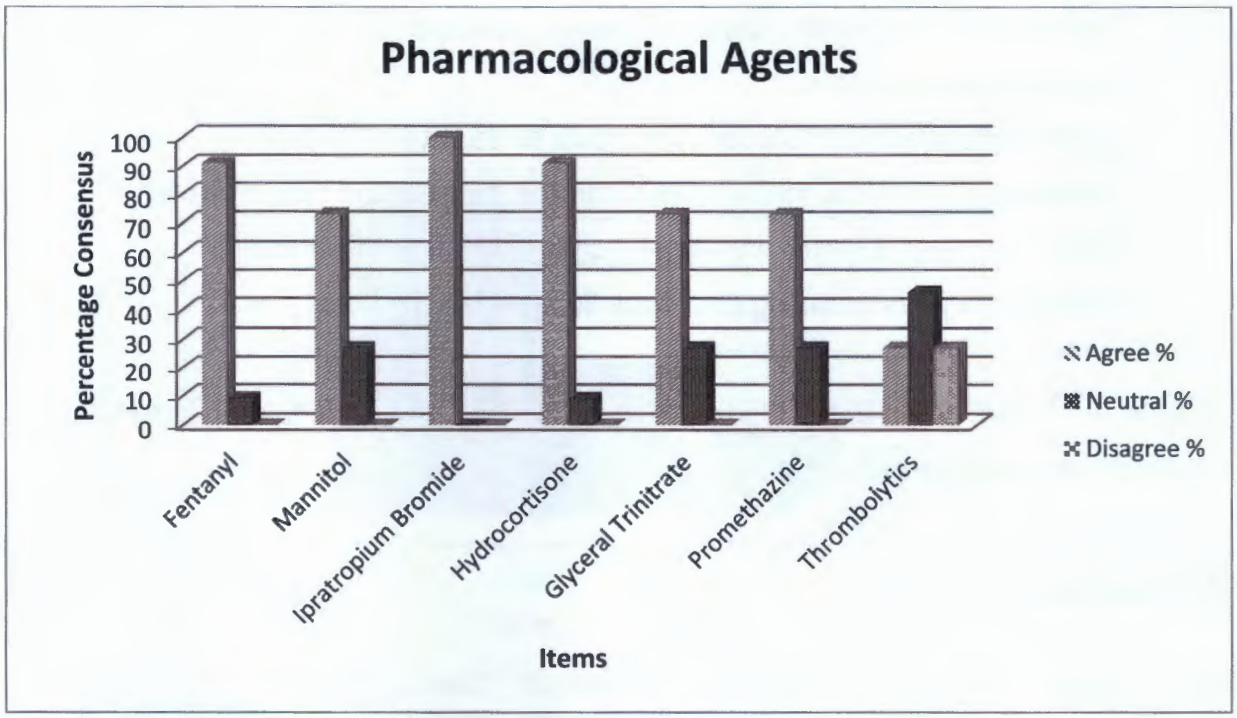


Figure 5.15: Percentage consensus of items in Pharmacological agent's category of iteration 2.

5.2.3 Comments from Iteration 2

The comments of iteration 2 suggested the following:

- The ECG monitors should be rugged and have extra-long leads and that a minimum of a 3 lead ECG be used to at least diagnose hyperkalaemia.
- It was also suggested that a 12 lead ECG is preferred over a 3 lead ECG.
- Intravenous administration sets be included on the list of items under circulation.
- Head blocks are bulky and can be fashioned on scene and therefore a Stokes basket and a KED may be a better choice instead.
- ABG machine is important but may be too fragile to take along.
- The ultrasound machine may be fine to use but that it may be too costly to maintain.
- Nitrile gloves are regarded to be better than latex gloves.
- Calcium chloride is useful in arrhythmias due to hyperkalaemia and is best in multi-dose vials (MDV) as prefilled syringes take up space.

- Fentanyl is excellent and if given judiciously has limited effect on haemodynamic profile.
- Hydrocortisone important for own crews as they tend to develop rashes.
- Ipratropium bromide, mannitol and nitrates are nice but not necessary.
- Ondansetron is a better anti-emetic compared to promethazine.
- There is no point in taking thrombolytic agents.

Based on these comments, Ondansetron was included with the pharmacological agents in the next iteration.

5.3 Iteration 3

Once again, 30 questionnaires were distributed, however only 8 responses were returned after iteration 3. The results are again revealed under the respective headings and displayed by the corresponding graphs.

5.3.1 Equipment

5.3.1.1 Airway

The oesophageal detector device (EDD) (63%) was again the only device included in this category and again it did not gain consensus among the participants.

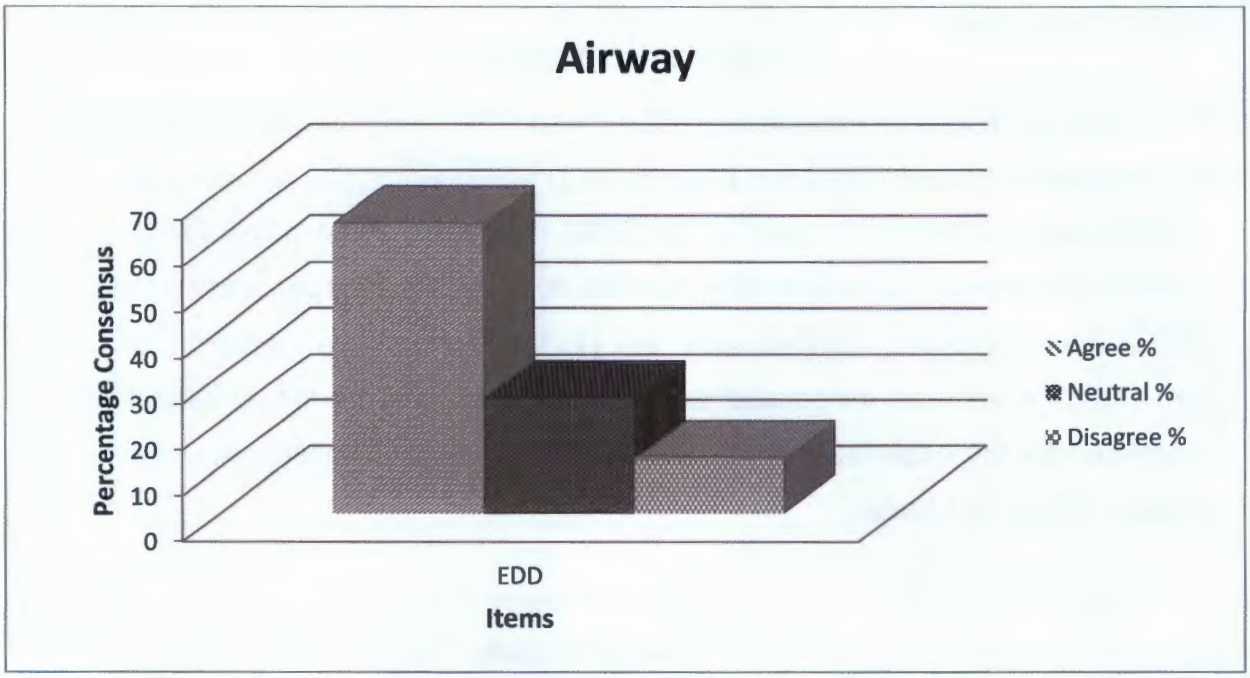


Figure 5.16: Percentage consensus of items in Airway category of iteration 3.

5.3.1.2 Breathing

The PEEP valve and portable capnometer were again both considered for iteration 3, however only the portable capnometer (100%) gained absolute consensus here with the PEEP valve (63%) achieving less than 85% consensus.

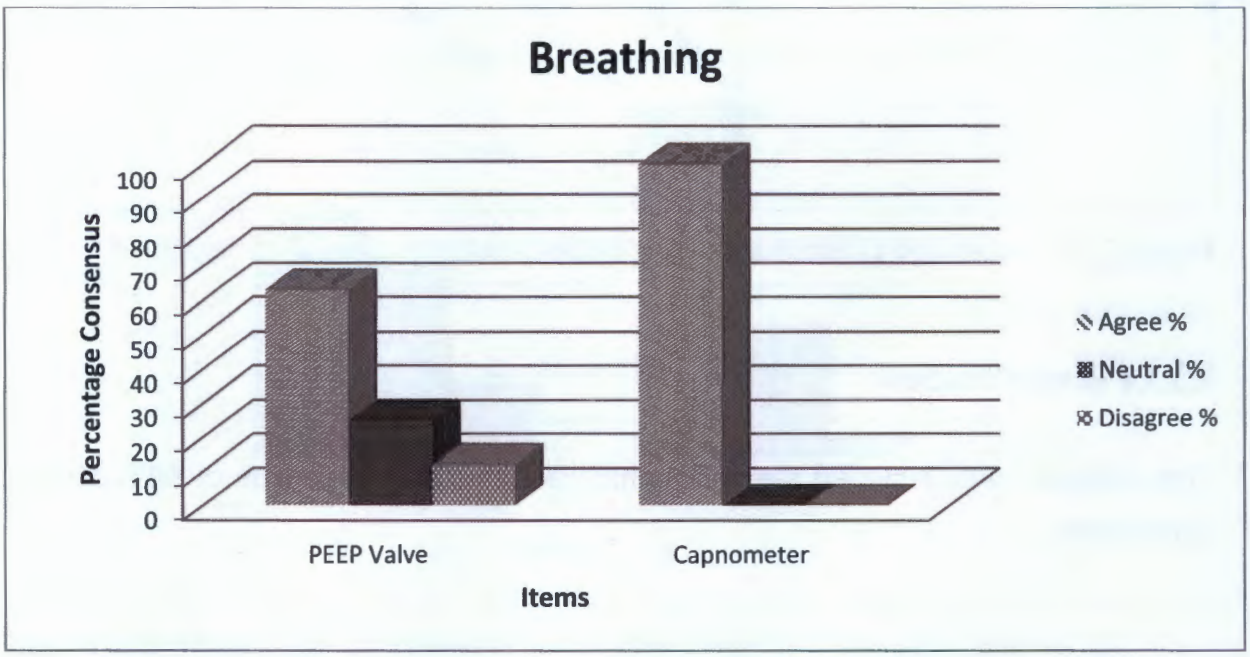


Figure 5.17: Percentage consensus of items in the Breathing category of iteration 3.

5.3.1.3 Circulation

The electrocardiograms / monitors (AED, 3 lead ECG and 12 lead ECG) were again included in this iteration; and this time the AED and 3 lead ECG achieved consensus of 88% each; while the 12 lead ECG (63%) and the syringe driver (75%) did not achieve consensus. It was in this iteration that the 60 dropper administration set (63%), the 10 dropper administration set (75%) and the rate minders / dial-a-flow sets (75%) were also introduced and assessed as part of the questionnaire, as suggested by the experts; however these did not achieve consensus. Results are shown in the graph below.

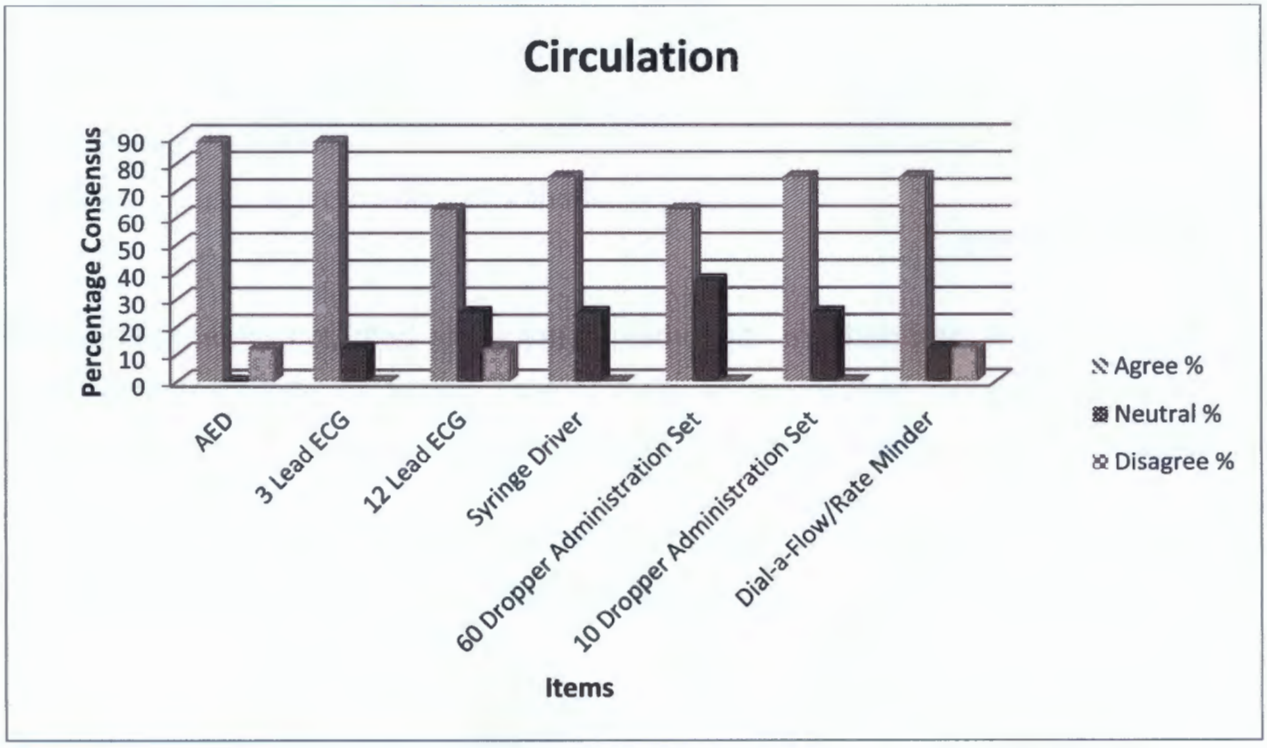


Figure 5.18: Percentage consensus of items in the Circulation category of iteration 3.

5.3.1.4 Immobilisation

This category only included the KED which achieved a consensus of 88% among participants.

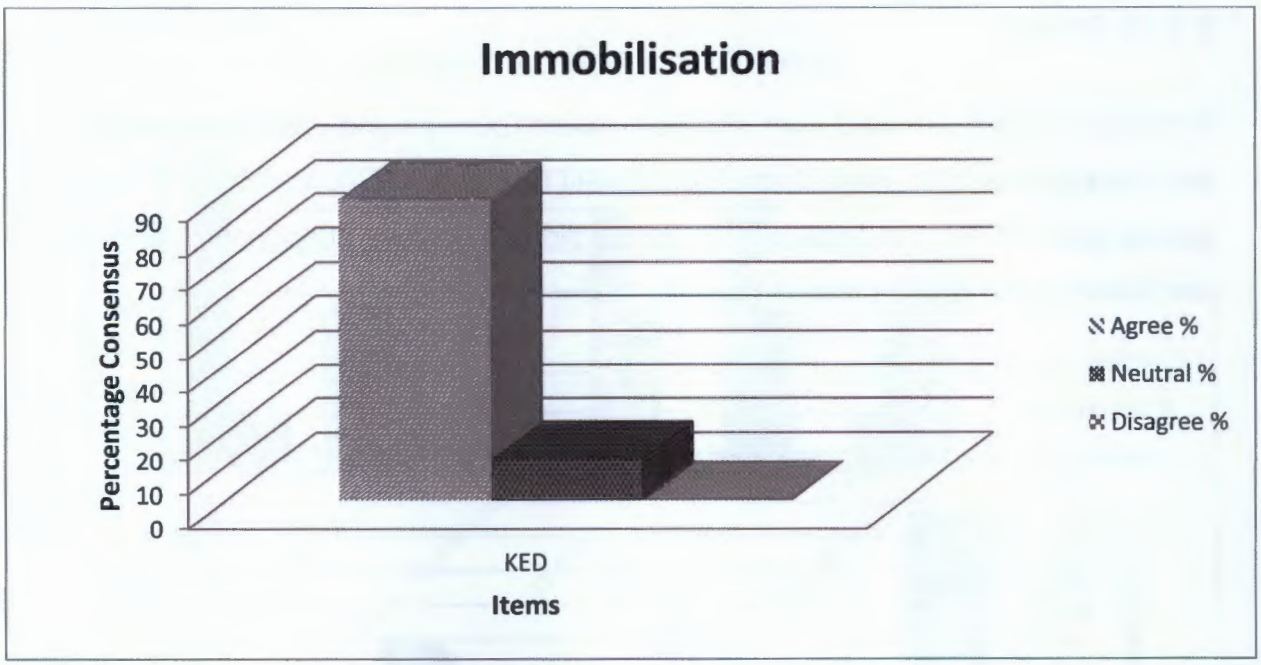


Figure 5.19: Percentage consensus of items in the Immobilisation category of iteration 3.

5.3.1.5 Diagnostics

Again the ABG machine (50%) and ultrasound machine (75%) were listed and again no consensus was reached with either of these items.

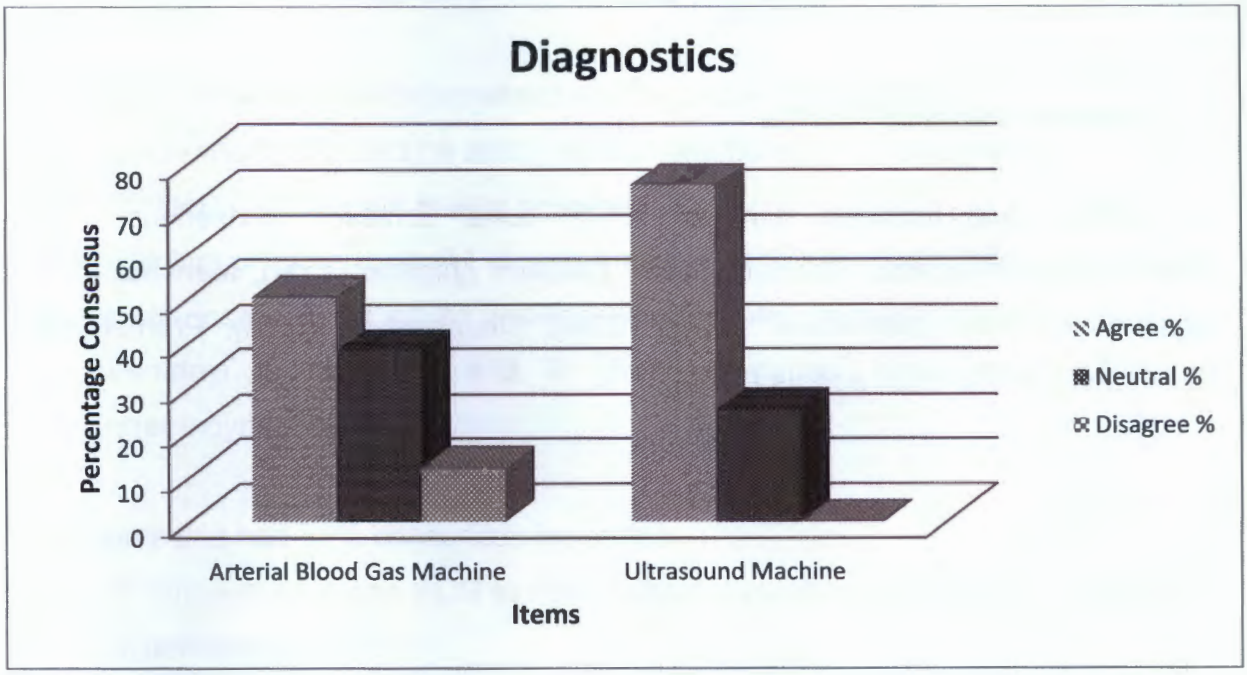


Figure 5.20: Percentage consensus of items in the Diagnostic category of iteration 3.

5.3.1.6 Other

Three items were included here, the burn shield (burn wound dressing); pacing pads and latex gloves; of these only the burn shield had absolute consensus (100%). The pacing pads (50%) and latex gloves (63%) did not achieve consensus. The results are shown in the graph below.

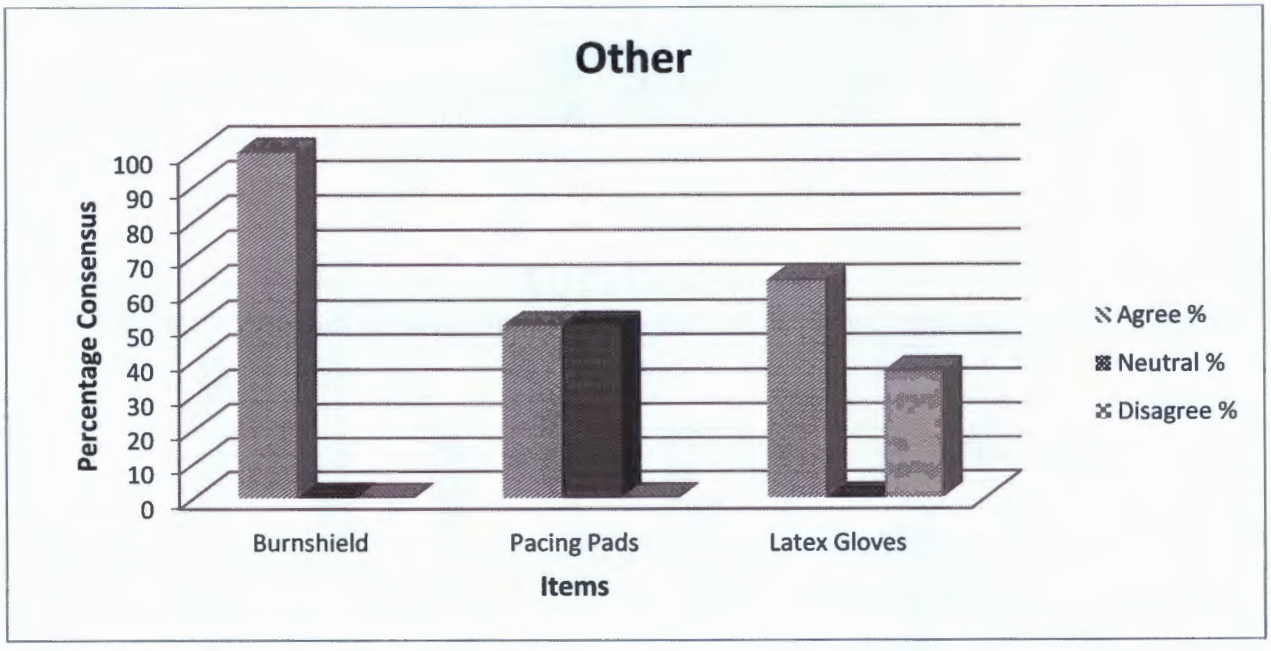


Figure 5.21: Percentage consensus of items in the Other category of iteration 3.

5.3.2 Pharmacological Agents

Six items were included here of which none achieved consensus. The pharmacological agents included that of Calcium chloride (75%), Mannitol (38%), Glycerol Trinitrate (nitrolingual spray) (63%), Ondansetron (63%), Promethazine (63%) and Thrombolytic agents (38%).

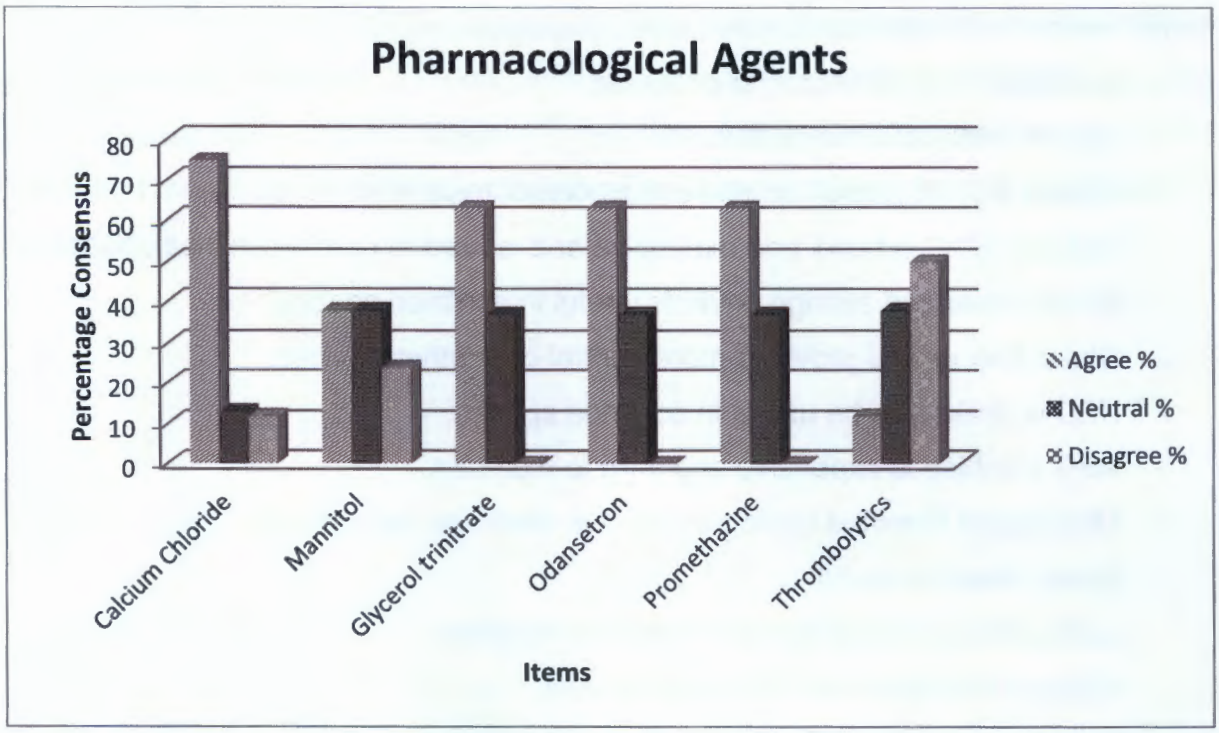


Figure 5.22: Percentage consensus of items in Pharmacological agent's category of iteration 3.

5.3.3 Comments from Iteration 3

The comments of iteration 2 were assessed and are reported as follows:

There was 100% (absolute) consensus on the following statements:

- ECG monitors should be small, rugged and have extra-long leads;
- Protective equipment is very important;
- Calcium chloride is useful in arrhythmias due to hyperkalaemia and is best in multi-dose vials (MDV) as prefilled syringes take up space; and
- Fentanyl is excellent and if given judiciously has limited effect on haemodynamic profile.

Comments that had 85% consensus included:

- A minimum of 3 lead ECG to assist with the wave morphology in patients with hyperkalaemia; and
- There is no point in taking Thrombolytic agents with.

Other comments that arose from iteration 3 included:

- End tidal CO2 monitoring is preferred.
- AED reported to be a must have.
- 3 Lead ECG is easier to use in situations of trapped patients.
- 12 Lead ECG is bulky and expensive and is hard to use in confined spaces.
- Battery operated syringe driver is useful in confined spaces.
- Dial-a-flow device provides more control over other devices.
- KED is unlikely to be useful in confined spaces.
- ABG machine is expensive and hard to maintain.
- Ultra sound machine could be useful in chest injured patients.
- Burns shield is useful.
- Latex gloves are a potential for allergic reactions.
- Calcium chloride useful for crush injuries.
- Mannitol may be difficult to use in the field as urine output needs to be monitored.
- Glycerol Trinitrate may be useful.
- Ondansetron is very useful and preferred over Promethazine.
- Thrombolytic agents are hard to justify and expensive.

The results have been included in this document and can be found under appendices D, E and F.

5.4 Statistical Analysis

Statistical analysis of the data was conducted using Cronbach's Alpha. Cronbach's Alpha aims to provide a measure of internal consistency and is connected to the inter-relatedness of the items of the questionnaire of the test.[48,49] This test was used to determine the reliability of the questionnaires for each iteration as well as each variable in this study. Cronbach's Alpha is generally expressed as a value between 0 and 1 but reports have led to acceptable values ranging from 0.7 – 0.95. It has also been stated by Gliem and Gliem that the closer the result is to 1 the better the internal consistency is of the items involved in the questionnaires of the test.[48,49]

The Cronbach's Alpha for iterations 1, 2 and 3 were ascertained and the values reported at 0.94, 0.80 and 0.94 respectively. A value above 0.8 is regarded as good while a value above 0.9 is excellent;[49] meaning that the internal consistency of the items and therefore the reliability of each of the questionnaires for this study may be regarded as acceptable.

Chapter 6 - Discussion

6.1 Items of the Medical Cache

Agreement among the experts was found on many of the individual items across the seven sections of medical equipment and pharmacological agents. There were also items that proved controversial across the three iterations with some only achieving consensus in the final iteration. The various sections will be discussed as follows:

6.2.1 Airway

This study revealed early consensus for the majority of items included in this category. The hand held suction unit along with the laryngoscope, Magill's forceps and the cricothyroidotomy kit all achieved early consensus. This was expected of the suction unit as well as the laryngoscope especially as these devices are essential instruments in basic and advanced airway management.

The hand held suction unit is portable and compact and does not necessarily require a power source as some are manually operated. Yet the specific type of suction unit would depend on the resources available as well as the type of incident to be deployed to.

A compact electric or battery operated device is thought to be well suited as it is able to generate more suctioning power as compared to the manual, hand held device. However because of the austere environment it may not be possible to always charge these units, making the manual suction devices not only a back-up option but possibly the only option in some circumstances.

A variety of electric / battery operated and manual suction units were evaluated. The majority of portable electric / battery operated suction units generate around 80 – 600 mm Hg suction power with a flow rate that ranges from 16 – 32 L / minute.[50,51] The handheld devices are said to generate around 170 – 380 mm Hg and 70 L /

minute suction power, with some makes even producing 500 mm Hg of suction power. Electric / battery operated suction devices have developed considerably and are more lightweight than before with weights ranging from 1.5kg – 4kg while the hand held devices weigh an average of 300 grams.[50,51,52] The collection canister of the electric / battery operated suction devices can store approximately 1000 – 1200ml of fluids, while the handheld devices are able to contain around 425mls of fluid.[50,51] The battery run life varies around 30 – 45 minutes.[50,51,52]

It can be seen from the above that the electric / battery operated devices are relatively lightweight, require a power source and compared to the hand held device they are able to hold more fluids and able to generate more suction power. The hand held devices however are able to generate sufficient suctioning power with some even as much as that produced by the electric / battery operated suction devices. Although the collection chambers hold less fluids they are more compact and also weigh less than the electric / battery operated devices. The hand held suction device could also be easily stored in the jump-bag and used in any confined space or environment.

In this study there is no intention to promote one make of device over another, yet it is imperative that when purchasing these devices for the medical cache that one would closely assess the specifications of the various makes of suction units so as to choose that which is best suited for the job.

It was expected that the EDD would also have achieved early consensus, however this was not the case. This device is compact and cost effective compared to other secondary confirmatory devices as well as durable but it might not have achieved consensus due to experts possibly not considering it as useful or as reliable as the capnograph or the portable capnometer.[53] An EDD can only determine whether the endotracheal tube is placed in the trachea or the oesophagus but cannot provide any other information to the practitioner. Also the EDD is only able to indicate this as long as there are no fluids in the airways or deliberate air leaks, as with paediatric patients.[53] Hussain, Jafri and Siddiqi assessed the accuracy of the EDD to detect endotracheal placement and compared its performance against the capnograph. They determined that the efficacy of an oesophageal detector device in confirmation

of endotracheal tube placement saw a sensitivity of 100% and a specificity of 100% and therefore found it to be effective in differentiating tracheal intubation from oesophageal intubation.[54]

Confirmation of endotracheal tube placement is usually by means of inspection, auscultation and use of confirmatory devices,[53,55] however these environments are usually loud, poorly lit and time critical. It may therefore be difficult to inspect and auscultate to confirm tube placement which means that confirmation would have to rely on some sort of device and in this case it would either be the EDD or the capnograph / capnometer. In this type of environment the capnograph / portable capnometer would have to be most suitable and reliable. The use of these devices together to determine confirmation might also be seen as duplication of equipment and therefore unnecessary. However as the EDD did not achieve consensus, it was not included in the cache, whereas the capnograph and the portable capnometer both achieved consensus by the end of the study and both where therefore recommended for inclusion into this medical cache.

The cricothyroidotomy kit was expected not to achieve consensus as it was anticipated that the experts would suggest that it may be cheaper to make up these kits on scene from individual items such as scalpel blades and forceps. However the individual items were not suggested in the Delphi, only the complete cricothyroidotomy kit, which did achieve consensus for inclusion into the medical cache. To keep costs low, it would be recommended to assemble a kit from individual items, some of which can be purchased in bulk, such as the scalpel blades and tape. The forceps may be purchased with relative ease and instead of the specific tracheal tubes found with the pre-packed kits; one could use a size 5.5 cuffed endotracheal tubes, which would be found in the medical caches airway disposable items.

Although the Magill's forceps may be regarded as a necessary piece of equipment in the airway management kit, no expectations were had regarding its inclusion. This piece of equipment is useful in assisting with endotracheal intubations as well as with the removal of upper airway obstructions; this is most likely why the experts agreed

on its inclusion. It is also a relatively inexpensive piece of equipment and does not require a lot of space for storage.

Oropharyngeal and nasopharyngeal airways; endotracheal tubes; supraglottic devices, etc. that are necessary as part of a medical cache, were not individually included in this Delphi questionnaire. These particular types of items may vary between suppliers in different regions and were found to form part of the basic and advanced airway management kits suggested by both FEMA and INSARAG. These would be included in the medical cache but the specific items would be dependent on the resources and training provided in the local regions.

Therefore the above list of disposable items along with the laryngoscopes, Magill's forceps, suction devices and Cricothyroidotomy kits are recommended for inclusion into this study's medical cache.

6.2.2 Breathing

This category achieved early consensus with three of the five items of equipment and only one item not achieving consensus across all iterations. As expected the bag-valve masks (BVM) for adults, paediatrics and infants achieved early consensus, as these items are necessary pieces of an airway management kit. BVM's are light-weight; durable, relatively inexpensive and they are generally designed for once off use but can be sterilized and used repeatedly if necessary. This low-technological device is well suited for these austere environments and requires little maintenance other than being kept clean and ready for use.

The mechanical ventilator achieved early consensus. This item was expected to find consensus but not as early as it did as it is a high technological device that requires maintenance, calibration and careful packaging during transport. Disaster incidences create further difficulties like access to victims, which makes the task of providing mechanical ventilation even more challenging.

Transport ventilators are well suited for this environment as they are small, rugged and easier to use than the larger type mechanical ventilators found in hospitals. However, there are ethical considerations to take into account prior to the decision of providing mechanical ventilation. It needs to be determined who or what type of patients will be ventilated especially when there are multiple patients involved, and what type and amount of resources are available on site. It has been said that emergency care practitioners should base their treatment decisions on what resources are available as well as the needs of the patient.[56] The issue with this statement is that there may be multiple patients needing mechanical ventilation but not enough ventilators available to do this, which again brings to question which patients are to receive mechanical ventilation and which are not? This ethical dilemma needs discussion by the medical rescue team prior to deployment.

The amount of ventilatory resources available would dictate who is ventilated and for this choice to be made certain criteria would have to be established to aid in this decision making process. The criteria should be as simple as possible for these types of situations; patients that are triaged as critical but not expectant, whose prognosis for a full recovery is good and that may be evacuated from the site relatively soon are potentially best suited for mechanical ventilation.[56] Though if a patient were to be deemed emergent with no chance of survival these patients would be treated palliantively until they expired or were moved from the rescue site.[56]

Unlike the ventilators used in hospitals which run off oxygen and air, transport ventilators generally work by means of oxygen alone which makes them more costly. This means that more oxygen reserves are required and as these are compressed cylinders of gas it may make transportation more difficult as these cylinders have to be stored and transported more carefully. It would also be necessary to ensure that the specific oxygen gauges be included along with extra rubber gaskets. Oxygen was not included in the list of pharmacological agents as this is considered a necessary item and forms part of the FEMA and INSARAG recommendations for a medical cache.

This ventilator would be kept at the base camp and only be used for critical patients awaiting immediate evacuation from the rescue site. It is therefore expected that not

many patient circuits would be required. The patient circuit is disposable and can be replaced easily as they can be purchased separately from the device, although in resource limited environments it may be considered to have these circuits sterilised for re-use. The number of patient circuits to be included would depend on the type of incident as well as the number of crew and the expected number of survivors.

The capnograph achieved early consensus but the portable capnometer only achieved consensus later on. It was expected to find both of these devices finding early consensus as the use of these devices is well documented and constantly promoted. Capnography or capnometery is regarded as the golden standard of intubation confirmation and ventilatory management whether in the pre-hospital or in-hospital environment.[53] Capnography / capnometery confirms endotracheal placement by assessing the waveform or digital numeric display indicating the presence or absence of carbon dioxide thereby confirming endotracheal tube placement in either the trachea or the oesophagus. Capnographs / capnometers are more expensive than devices like the EDD and are either independent battery powered devices or part of an ECG monitor. These devices would also have to be rugged as the working environment is harsh and generally confined which makes treating the patients found that more complicated.

It was felt by some experts that as most ECG monitors manufactured nowadays come standard with capnography, that it may be unnecessary to include a separate portable capnometer. This could be a reason why the portable capnometer only found consensus in the third iteration as it may have appeared inferior to the standard waveform capnograph that is commonly used currently. However, as some ECG monitors come standard with a built-in capnograph, blood pressure cuff, pulse oximeter and temperature probe, if one of these components on this monitor had to fail or malfunction; such as the capnograph, it may then be worth having individual pieces of equipment.

This medical cache would include these independent devices in the event that the ECG with built-in capnograph becomes faulty and of no use; or if two critical emergency cases are being treated simultaneously then both devices could be used.

Along with these devices, extra collection tubes as well as extra batteries would also be included in the cache.

The PEEP valve did not attain consensus throughout any of the iterations, this was unexpected. The PEEP valve device is commonly used for patients during airway and ventilation management situations such as profound hypoxemia due to flail segments, pulmonary contusion, aspiration and haemorrhage; which may be common in disaster incidents.[57] These devices are either disposable or reusable and are designed to be used with BVM devices as well as mechanical transport ventilators as they are small, cheap and easy to use. This device is used when transferring patients from one hospital to another when PEEP has to be maintained during transportation. However disaster environments require the immediate evacuation of unstable patients who might not tolerate PEEP as well as what a prepared, stable transfer patient would; as these patients may potentially be hypovolemic or have complicating chest trauma.[57] This is possibly why this device did not achieve consensus in this study and was not included as part of the medical cache, even though it was found to form part of the medical cache of FEMA.

Specific oxygen delivery devices such as the various facemasks, nasal cannula, oxygen tubing and nebulisation masks were not included in this Delphi study. However they are invaluable as they are necessary to provide supplemental oxygen to patients. These devices are disposable, relatively cheap and easy to store and transport.

The medical cache would therefore include the above mentioned oxygen delivery devices, the bag-valve masks for adult, paediatric and infant patients, the mechanical ventilator, the capnograph and the portable capnometer.

6.2.3 Circulation

Not unexpectedly consensus was initially reached on most of the items in this category, but it was surprising that only the tourniquet achieved consensus after the first iteration and that the AED and 3 lead ECG monitor only found consensus in the

final iteration. The 12 lead ECG did not achieve consensus across any of the iterations which was also unexpected as the experts commented that they preferred the 12 lead ECG over the 3 lead ECG monitor. It was also stated that these 12 lead ECG monitors were considered to be expensive, bulky and difficult to use in confined spaces. It was then proposed that since the 3 lead ECG achieved consensus that it would be best if it were small, rugged and had extra-long leads as the areas the medics had to enter would be debris filled and confined. While the AED only achieved consensus in the third iteration experts were of the opinion that it was a must have as part of the medical cache. The 3 lead ECG is small, just as rugged and also capable of diagnosing hyperkalaemia and other life-threatening arrhythmias and therefore forms part of the medical cache.

A statement was made regarding the ECG monitors requiring extra-long leads in order to facilitate difficult extrications in enclosed spaces. The standard cable length is around 3 – 3.6 meters, but it is possible to have extra length cables up to 6 meters in length.[58] The cable, leads and clips can be custom designed to whatever the rescue medical team requires. These extra-long leads may be considered beneficial for the rescuers as they are required to crawl into really narrow or confined spaces, however if the monitor screen were at a great distance from the patient irrespective of the extra-long leads, it would be difficult to monitor the patient or to treat the more life threatening arrhythmias unless the defibrillator paddles too had extra-long cables. On the other hand due to the futility of trauma resuscitations in disaster events it is unlikely that defibrillation would occur in this environment, this also means that a lower value is placed on 12 lead ECG's and justifies not including it in this medical cache.

After iteration 2 some experts suggested that 60 dropper and 10 dropper intravenous administration sets as well as a rate minder / dial-a-flow device should be included, however neither of these found any consensus in iteration 3. This was very surprising as these items cannot be omitted as they are necessary for the intravenous delivery of fluids and medications to victims or crew members when requiring treatment. While conducting the research it was found that FEMA use multi-functional tubing and a dial-a-flow device[15] while INSARAG has no specifically

defined devices[16], as these would depend on the resources available to the particular USAR team.

It was stated by some participants that a 60 dropper administration set would be best suited instead for an infusion device, yet the majority of experts were undecided in this regard. By including the 60 dropper intravenous administration device and the dial-a-flow device in the medical cache it would be able to take the place of the syringe driver as this device did not achieve consensus across any of the three iterations. This was relatively expected as this device is costly and requires maintenance and calibration. Due to the nature of the disaster incident and the potentially austere environment the medical team can find themselves in, the syringe driver, may not be a viable option within a confined space or when rapidly evacuating a patient. For these reasons a 60 dropper intravenous administration set with a dial-a-flow / rate minder is better suited as an infusion device.

Disaster incidents tend to result in patients being entrapped for extended periods of time with very often severe injuries being sustained; therefore a high flow 10 dropper intravenous administration set would be best suited to provide these patients with large and rapid fluid boluses.

Other disposables related to circulation include the various sizes of intravenous catheters; syringes and hypodermic needles to draw up medications or administer via intramuscular or intravenous paths; as well as alcohol swabs and tape or other securing plasters. The inclusion of the specific types of this disposable equipment would be based on what is current practice as well as what is available within that region.

This category sees the inclusion of the intravenous administration disposables, along with the tourniquets, the AED, a rugged 3 lead ECG monitor with extra-long leads (if required by the rescue team), the 10 dropper and the 60 dropper administration sets as well as the dial-a-flow / rate minder devices.

6.2.4 Immobilisation

Half of the equipment included in this category achieved early consensus while the other half achieved mid to late consensus. It was expected that all these items would have achieved early consensus as they are necessary to remove and transport patients from the incident site or base camp to a stabilisation point or receiving facility. It was only the scoop stretcher, long spine board and spider harness that achieved early consensus in this category. This may have been due to the fact that they are considered basic immobilisation devices.

The scoop stretcher can be considered well suited for the medical cache as it is made out of light weight material and has hinges so that it can be folded up to make transportation and storage easier. In terms of the current debate around the efficacy of spinal immobilisation, scoop stretchers have emerged as the device of choice of the transfer of patients. It can be manoeuvred into confined spaces and is designed to be used without having to log-roll a patient. Situations where log-rolling the patient is a necessity would then benefit from the use of a long spine board. These spine boards are usually made out of wood or plastic, they are less expensive than the scoop stretcher and although they do not fold up like the scoop stretcher, multiple boards can be stacked on top of each other to save space. Long spine boards are also rugged and able to withstand large amounts of wear and tear.

It was suggested by some of the experts that the head blocks may be too bulky and that it might be a better idea to fashion these on scene, this can be done by using a blanket-roll for example, for this reason it was suggested by the participants that the Stokes basket and KED might be a better option instead.

The Stokes basket was expected to achieve consensus after the first iteration as this item is widely used during search and rescue exercises. This item can be folded into two pieces making it less bulky for transport purposes however it is still a heavy piece of equipment although it is able to withstand a lot of wear and tear and can be used to move patients out of narrow spaces. This piece of equipment only achieved consensus in iteration 2, which could have been due to it appearing alongside the KED and head blocks and therefore perceived as the only immobilisation device in

this iteration. It is also possible that the participants may have forgotten that the long spine board and the scoop stretcher achieved consensus in the previous iteration and considered it in its individual capacity rather than as an alternative to the other devices.

It was expected that the KED would have achieved early consensus but this was not the case. This may be due to the fact that certain experts felt that the KED may not be of any use within a confined space. However it may actually be a valid option to include this as it is a relatively rigid device designed to immobilise the upper torso, neck and head of an entrapped victim, and has handles to drag or pull the patient out of the confined area without compromising life or the patient's C-spine. As for the statement that it may not be useful in confined spaces, the design of this piece of equipment is well suited for entrapped patients in confined spaces especially when considering the alternative is a very rigid long spine board or Stokes basket. This is not to say that the long spine board and Stokes basket should not be included, as they have their particular usefulness once the victims have been removed from the confined spaces or when unable to use any other device. As this device immobilises the patients head and neck with minimal bulkiness it could mean that less head block devices are required to be taken into the search field as these could be kept at the medical base camp and used only when packaging patients for evacuation. This would also minimise time spent in the field. The KED is also well suited for the immobilisation of paediatric victims compared to the use of long spine boards.

The medical equipment to be included into the medical cache is therefore the scoop stretcher, the long spine board, the spider harness, head blocks with base plate, Stokes basket and the KED.

6.2.5 Diagnostics

This study revealed early consensus with the majority of items included in this category. These items included that of various diagnostic pieces and it was expected that these would achieve early consensus which they did.

Diagnostic equipment can be either manual or electronic devices. Devices such as blood pressure cuffs, pupil torches, stethoscopes and thermometers are the standard manual diagnostic equipment which on the whole is relatively inexpensive when compared to other diagnostic equipment. Glucometers, some thermometers as well as certain blood pressure devices may also be battery operated, while others such as the blood pressure cuffs and vital signs monitor are electronic. These items are ideal as they are light weight and take up minimal space when packing for the medical cache.

Electronic diagnostic devices such as the vital signs monitor, which achieved early consensus, have various capabilities. They include 3 lead ECG analysis capabilities, pulse oximetery, blood pressure monitoring and end-tidal CO2 monitoring. They require a power source but once charged the battery life can extend over many hours and this type of item would be suited for use either in the field or at the base camp medical post. This type of device is compact and rugged and as with the 3 lead ECG machines it can be designed with an extra-long cable and leads. This device is smaller and lighter than the 3 lead ECG machine and is able to provide almost the same functionality as a 3 lead ECG monitor, most importantly in this setting to identify life-threatening arrhythmias. The major difference however is that it does not have defibrillation capabilities. Therefore if the 3 lead ECG machine were to fail this could be used as a back-up device to only monitor the ECG rhythm; and if the vital signs monitor failed one could fall back on using the standard manual diagnostic equipment.

The two items that did not achieve consensus included the ultrasound machine and the ABG machine. The experts stated that the ABG machine might be an important adjunct and that the ultrasound machine may be useful in diagnosing chest injuries in trauma patients however they also agreed that both these devices were too fragile and costly to maintain to warrant being included on a rescue mission.

The equipment to be included in the medical cache from this category is the standard manual and battery operated diagnostic equipment (stethoscope, blood pressure cuffs, glucometer, pupil torch and thermometer). The vital signs monitor with all attachments will also be included here.

6.2.6 Other

The study found that early consensus was achieved with the majority of the items included in iteration 1 which included the ALS drug bag, ALS jump-bag, rescue scissors, blankets, the refrigerator / cold storage, sharps containers and the triage tags. It was expected that the drug bag and jump-bag would achieve early consensus as they are commonly used in the pre-hospital environment to store all the necessary life-saving equipment and pharmacological agents. It was also expected that the refrigerator / cold storage would achieve early consensus as this is considered necessary to keep medications cool in the harsher dry and hot environments.

The drug bag would be stocked according to the agreed upon pharmacological agents although quantities of these pharmacological agents or that of the drug bag were not addressed in this study. Multiple drug bags should be included to supply the multiple search and rescue teams who are deployed. Practically speaking the number of drug bags are likely to be dependent on the number of search teams that are searching simultaneously during a shift as well as a drug bag to be kept at the base camps medical post along with a spare. These drug bags would be the responsibility of the overseeing medical practitioner and would be used in conjunction with the ALS jump-bag.

A number of additional items such as the rescue scissors, blankets, sharps containers and triage tags were also considered essential items for this medical cache. The need for refrigeration / cold storage was considered by all participants who agreed that a system to keep pharmacological agents cool is essential and that a refrigerator / cold storage system should be included into the cache. Certain agents including vaccines, antivenom, paralytics and induction agents, require a temperature of 2° - 8°C to maintain viability.[59] The most common refrigeration / cold storage means is that of an electrical refrigerator which would require running off power such as a generator. If this were to fail a back-up method would be required, which could temporarily be achieved with cold packs. According to a manufacturer of a specific heavy duty, re-useable ice pack; dry ice packs used in conjunction with

a solid insulated container with a tight lid can potentially keep items cold for days.[60] There is limited objective scientific evidence for this though.

The emergency / chronic drug box and the pacing pads did not achieve consensus after the first iteration, this was expected of the pacing pads but not the emergency / chronic drug box. The emergency and chronic drug box is different to that of the traditional medical rescue drug bag as its intended use is that of a fixed medication chest which would be held at the medical base camp, whereas the drug bag would accompany the USAR team into the field.

The emergency and chronic drug box would include emergency resuscitation pharmacological agents as well as comfort medications such as over the counter analgesics, anti-inflammatory agents, anti-emetics, antacids, etc..., to be used mainly by team members and if required, the victims that had been recovered. It would also include any chronic medications used by the search and rescue team members, as these would be managed by the emergency care practitioner overseeing the medical base. The drug box was however not included as it did not reach consensus among the experts, this could be speculated that because a drug bag was already included in the list of items that another was not required or that they might not have understood the reason for including an emergency / chronic drug box.

Post iteration 1 the experts suggested additional items to be included. The personal protective equipment (PPE) such as facemasks, goggles and the nitrile gloves all achieved early consensus in this iteration which was also expected. PPE is essential as the rescue teams may find themselves in a constantly changing and potentially extremely hazardous situation. The latex gloves did not achieve consensus, however this was not unexpected as latex gloves potentially have a higher risk of causing allergic reactions and its use internationally is waning. The comments made suggested that the nitrile gloves were superior to the latex gloves and it was therefore agreed by all participants that nitrile gloves be included in the medical cache and that all latex items be avoided as far as possible. The exact types of PPE would be dependent on the local regions resources.

After iteration 1, a participant commented that certain equipment pieces be included in the medical cache; this list of items comprised of a satellite phone, passports, visas, money in small denomination notes, on site portable radios simplex and duplex, off-site radio communications and repeaters and power sources or generators. This equipment however was purposefully not included in later iterations; as the study was limited to assess medical equipment and pharmacological agents only at this time.

6.2.7 Pharmacological Agents

This study revealed 28 medications that made up this category. The medications varied from antibiotics to thrombolytic agents. After iteration 1 the majority of pharmacological agents were agreed upon with minimal items returning in iterations 2 and 3. It was expected to find that the more common agents achieved early consensus which many did. It must be noted that the pharmacological agents discussed here are intended for use by the members of the search and rescue team as well as those immediate victims found.

Antibiotics achieved consensus after iteration 1 which was expected as these may be necessary for both rescuers and victims. Consensus was reached on including broad spectrum antibiotics; the specific agents would usually depend on the type of condition but should only be administered when absolutely needed. The austere environment lends itself to crews potentially being injured as well as delayed rescues. These together with the lack of basic sanitation and fresh water lend itself to a high risk for significant infections. A review of local disease risks and prescription patterns further would be required to identify the specific types of broad spectrum antibiotics to be included in this medical cache. This would generally be region specific.

It was surprising that Hydrocortisone did not achieve early consensus and that Promethazine did not achieve any consensus as these agents are important for treating any allergic reactions the crews or immediate patients may develop.

As Promethazine did not achieve consensus, it was suggested by experts that Ondansetron be included instead as some considered it to be a better anti-emetic. No consensus was achieved across 3 iterations and thus neither agent was to be included. However, as there is no other anti-histamine suggested and the risk of allergies is relatively high it was felt amongst the participants that some sort of anti-histamine needed to be included. Ondansetron has no anti-histamine effects whereas Promethazine is an effective anti-histamine and as no other anti-histamine had been suggested, Promethazine was included in the cache. Promethazine is also found in the ALS HPCSA protocols, which is used by all advanced life support practitioners within South Africa and is a familiar agent to many. Ondansetron was also considered to be a relatively expensive drug when compared to the reasonably priced Promethazine.

Surprisingly Calcium Chloride was one of the drugs that did not reach consensus across the three iterations. Absolute consensus was reached on the statements suggesting that Calcium Chloride is useful in crush injured patients especially those with arrhythmias due to hyperkalaemia and that it would be best if it was in a multi-dose vial rather than pre-filled syringes as these take up space.

Entrapped victims are at high risk of developing hyperkalaemia because of the prolonged time of entrapment. Once they are extricated these victims may present with non-specific signs or complain of muscle weakness, confusion and potentially palpitations. On further examination they may present with ECG changes indicating hyperkalaemia which would require the immediate administration of pharmacological agents such as crystalloid fluids, sodium bicarbonate, as well as calcium chloride or calcium gluconate.

While Calcium Gluconate may be regarded as the preferred pharmacological agent in the treatment of hyperkalaemia, it was not initially included in the list of pharmacological agents as it did not form part of the list of medications carried by paramedics working in South Africa, nor was it suggested by any of the expert participants during any of the iterations.[61] Calcium Chloride is 3 times stronger than Calcium Gluconate however as long as equivalent doses are used they work equally fast.[61, 62]

Analgesia achieved early consensus and finding the most appropriate analgesic agent has proved difficult as there is limited evidence for determining an optimal pain medication protocol for disaster incidents. It has been thought that an ideal pain medication should be one that is carried and stored without concern for temperatures or the environment.[63] It is also suggested that the agent should have a high therapeutic index and be used for all types of pain as well as across all patient populations.[64] The reality is that finding one specific pain relief medication to fulfil these requirements is challenging. Pain relief pharmacological agents include items such as non-steroidal anti-inflammatory agents like Ibuprofen, opiates such as Morphine (oral and intravenous), Fentanyl Citrate (oral), Butorphanol (intranasal), Ketamine (intravenous or intramuscular), as well as regional anaesthesia.[64]

Anti-inflammatory agents such as Ibuprofen may be well suited for use by the team members as these agents assist in reducing pain and fever without causing sedative effects. A concern with this type of pharmacological agent is the risk of bleeding or perforation of the epigastrium or intestine in patients sensitive to the agent or with predisposing factors such as peptic ulceration. It was expected of morphine to achieve early consensus which it did. This agent is also commonly used by most pre-hospital providers and this high rate of familiarity suggests that it is reasonably safe. Fentanyl was also suggested by the experts and early agreement was reached on its inclusion into the medical cache as it was found to be an excellent agent if given judiciously as it had limited effect on a patient's haemodynamic profile. However, Fentanyl is not available in the public pre-hospital system and practitioners may not be as familiar with its use. It is also more costly.

It was also found that FEMA include Fentanyl pops as part of their pharmacological agents. Fentanyl pops are a lozenge of fentanyl citrate on a small stick, like a sucker or lollipop, that is absorbed across the buccal mucosa of the mouth when sucked within approximately 5 minutes.[65] As Fentanyl was agreed upon for this medical cache, the form in which it is administered would include that of pops / suckers and not only intravenous / intramuscular agents as these would be easier to use as well as minimise the risk of overdosing a patient. The acquisition form of Fentanyl, (intravenous, intramuscular or oral, such as the pops) would be dependent on what is available within the particular region as well as the costs involved and to a degree

the level of practitioner qualification that may have to prescribe or administer this pharmacological agent. As for this medical cache Fentanyl would be included.

It was no surprise that Glyceryl Trinitrate (Nitrolingual spray) did not achieve consensus as this agent is indicated for the treatment of myocardial chest pain and although there would be a variety of patients, the majority would be trauma related with few medical cases expected. However Glyceryl Trinitrate forms part of the ALS scope of practice in South Africa and as such it will form part of the personal response drug bag when deploying to disaster incidents.

Mannitol was included but did not achieve consensus. This was not expected as it is potentially useful in the treatment of trauma patients, particularly those with head injuries and crush syndrome. However the participants commented that mannitol may be difficult to use in the field as the medical practitioner constantly needs to monitor how much fluid is being administered along with urine output, which is not always possible in a disaster situation.

Ipratropium bromide did reach consensus for inclusion, this was expected as it is commonly used in conjunction with Beta 2 stimulants, which are considered the more essential agents. It was later suggested by some of the participants that Nitrates, Mannitol and Ipratropium bromide were nice to have but not a necessity.

Thrombolytic agents were included in the questionnaires but did not reach consensus. This was no surprise as there are concerns with including these pharmacological agents in that once this medication has been administered patients should not be moved for at least the first hours as the opportunity of developing arrhythmias and cardiac arrest is relatively high. Also as there was no consensus reached on the inclusion of a 12 lead ECG into the medical cache, and the medical personnel would only have a 3 lead ECG available, this would make diagnosing myocardial infarctions and localizing them more challenging. Along with these complications is the fact that USAR teams travel to various countries with various language barriers which would make a complete and accurate history taking that more complicated and time consuming. It was felt by experts, that there would be no point in taking these along as it may be difficult to justify their use, as well as

expensive and as these patients require constant monitoring and rapid access to higher levels of care, this too could not be guaranteed.

Unsurprisingly intravenous fluids achieved early absolute consensus. Ringers Lactate and Sodium Chloride are regarded as the standard fluids to be included into a medical cache. These are isotonic fluids and can therefore be administered to all patients requiring fluid replacement or the administration of medications. The reality is that in a disaster incident the potential for poly-trauma is high. These victims, when found, are likely to have multiple injuries and if rescue time is prolonged, these injuries could be further complicated by dehydration and blood loss. Therefore fluid replacement is necessary and may require a large volume which means a large number of these fluids would have to be included in the cache.

Sedation, induction and paralytic pharmacological agents such as: Diazepam, Midazolam, Ketamine, Etomidate, Suxamethonium, Rocuronium and or Vecuronium all achieved consensus for inclusion into the final medical cache. This was expected as they are the main pharmacological agents currently used in the pre-hospital environment as well as in most trauma centres when managing the airway. These agents may therefore be regarded as extremely useful when managing trauma patients. However the one concern with these medications is that the majority of them need to be kept cool (Etomidate, Ketamine and Vecuronium require temperatures below 25°C, as per package insert) and protected from light; whereas Rocuronium and Suxamethonium need to be refrigerated at between 2 - 8°C (as per package insert).[66] It is for this reason that cold refrigeration / storage is necessary and should be provided.

It was however found that should refrigeration not be possible, some pharmacological agents could remain outside cold storage for a maximum of 30 days as long as the ambient temperature did not exceed 30°C.[67,68] This cannot be assured though as the environments are usually harsh and unpredictable.

Pharmacological agents that were not involved in this study but were included in the medical cache comprised that of anti-tetanus, rabies vaccine and anti-venom. These pharmacological agents were also suggested for inclusion by FEMA and have been

regarded as very useful in the types of de-constructed environments that these rescue members will enter. The risks for tetanus, rabies and envenomation's are extremely high in these disaster situations due to debris, rodents and other rogue non-vaccinated animals as well as snakes due to the disruption of the environment. It is possible that the anti-tetanus and rabies vaccines could be given to team member's prophylactically prior deployment and that anti-venom is included in the event of a snake bite. The type of anti-venom would depend on the location of the disaster.

If within Southern Africa, anti-venom can be obtained from the only manufacturer in Johannesburg, South Africa. These include the more commonly used polyvalent anti-venoms for the treatment of adder, viper, mamba and cobra bites; while the less commonly used monovalent anti-venom includes that for the treatment of the boomslang's bites. The concern here is that these agents also need to be kept cool at a temperature of between 4 - 8°C.[69] Commercial snake bite kits are available for purchase although these could be fashioned prior to departure or on scene from the equipment and pharmacological agents already agreed upon and available. These kits should contain the following items: basic airway and breathing assessment and maintenance equipment (stethoscope, airway adjuncts, oxygen delivery devices and bag-valve-masks); suction units (electrical or manual); intravenous catheters, large bore administration sets and isotonic fluids; pharmacological agents should include that of adrenaline (1:1000); antihistamine (promethazine) and ultimately, rapid transport to the most appropriate emergency department.

Iteration 1 saw the inclusion of a refrigerator / cold storage which would make it possible to store the sedation, induction and paralytic agents along with the antivenom, anti-tetanus and rabies vaccines.

The study did not consider what would happen to the pharmacological agents once the team leave the disaster site as taking pharmacological agents back over borders or even locally may be difficult as these agents have been kept in the austere environment and therefore potentially not re-useable or exchangeable. This would have to be further investigated in a follow-up study.

6.3 Costs, Benefits and Disadvantages

Equipment numbers required may be less for responding to disasters within the province and possibly within the country of South Africa as there are a number of hospitals available in close proximity. There are also many areas, including that of the Western Cape, that are separated from hospitals by large distances. Many rural areas that is under-resourced, understaffed and potentially under-qualified to deal with a disaster incident.

The cost and availability of resources is important to determine, yet this was not assessed in this study and would require a follow-up study to determine this. This must be kept in mind though when deciding on what equipment should be included as resources tend to vary among provinces and countries. It is important to consider what is locally appropriate and to ensure that whoever takes control of the medical cache is familiar with all the medical equipment and pharmacological agents.

It was evident from the analysis that the medical cache would benefit from low-technological devices instead of those that are fragile and expensive to maintain or replace. Limited space was a concern for two reasons; one because rescuers would be faced with small, tight, confined spaces when searching for victims, this means that smaller sized and light-weight medical equipment is best. The second reason would be when packing for these rescue missions, packing space is limited as rescue equipment is often bulky and plentiful.

Another logistical concern that may arise is that of cleaning or sterilising equipment. There are no auto-claves or similar sterilisation systems available in the austere environment. Judicious use of concentrated virucidal disinfectant solutions can achieve a reasonable level of cleanliness for healthcare related equipment in rescue missions. The exact type of solution was not assessed in this study but would depend on the type of rescue mission, the type of equipment requiring sterilisation and the available disinfectant solutions.

Some forms of sterilisation include that of boiling instruments for at least 20 – 30 minutes however this method will only destroy HIV and hepatitis B but will do nothing

to the spores and will increase the likelihood of rust. Hypochlorite's also known as bleach may be used for metal instruments and sterilisation requires soaking for at least 15 – 30 minutes before being rinsed thoroughly and dried. These solutions also increase the likelihood of rusting. Other techniques include soaking instruments in Isopropanol alcohol 70% for about 15 minutes (alcohol soak) or coating them well with rubbing alcohol or vodka and setting them alight (alcohol flaming). A further option is that of a pressure cooker / pot usually used to speed up cooking time. If managed correctly this pressure pot could be used as a portable autoclaving device.[70] Extreme caution would have to be maintained and enforced when using this device as it has a high risk of exploding.

6.4 Implementation

Once all aspects of this medical cache have been established, the aim is to incorporate them into the provincial emergency and rescue services. Considerations such as the quantity of items; where the medical cache will be stored; how it would be transported upon activation; who will oversee the medical cache and ensure stock turn-around is monitored were not assessed in this study, and therefore further studies would be required to answer these questions so that a formal policy with set criteria can be established regarding the medical cache as a whole.

It is however expected that the provincial government will control and manage this medical cache and that a few key players, for instance the air force / military will assist by warehousing the medical cache or assisting in the transport of the medical cache to the disaster area.

It would be beneficial if the medical cache were managed by an Emergency Physician or an Advanced life-support Paramedic with experience in pre-hospital emergency medicine and who has had some experience and training in disaster response. It would also be beneficial if they were to have previous experience in the development / packing of a medical cache. Besides having a designated medical cache manager, other personnel would be required to ensure the equipment is regularly checked, maintained and audited. The "push packages" of the USA have a Technical Advisory Response Unit consisting of various individuals such as public

health experts, logisticians and emergency response specialists. This team is responsible for ensuring material transfers and coordination.[71]

It would be well suited if this cache were indeed stored in a military type warehouse as these are large enough to house the medical equipment and pharmacological agents as well as providing security to ensure the safety of the equipment and various medications amongst other items. Certain medications may have to be stored at the specific suppliers to maintain appropriate cold storage, monitor expiration dates and ensure appropriate levels of access to restricted drugs. Specific transport allocations could be made for this medical cache as well as the accompanying USAR team. This would assist in minimising deployment times as well as safe transportation of oxygen or other types of gas cylinders.

Consensus among experts enabled the determination of this evidenced based medical cache; the aim of which is to guarantee that the dedicated, multi-skilled, urban search and rescue teams would be supported while assisting disaster-stricken communities. The term support refers not only to providing immediate care to direct victims but essentially to the health and safety of the search and rescue team. To move forward from this point would be to acknowledge the need for this medical cache and continue investigating so as to determine the best suited storage facilities, the best means of transportation as well as who would take accountability for this medical cache and who would assist with maintaining it. Policies would have to be established to set the foundation for this medical cache.

6.5 The Proposed Medical Cache

Although this study has enabled the establishment of this medical cache by determining the medical equipment and pharmacological agents to be included; this cache may still need to be flexible as it is designed to be used in a variety of environments for all types of disasters and the cost or finance of it would depend on what the local, national or international concerns were capable of providing. This cache will ensure that a dedicated, multi-skilled, urban search and rescue team would be supported while assisting disaster-stricken communities.

Category	Hard Items	Disposable Items
Airway	Suction device	Hard and soft tip catheters
	Laryngoscopes	Endotracheal tubes
	Cricothyroidotomy Kits	Oropharyngeal airways
	Magill's Forceps	Supraglottic devices
		Batteries
		Introducers
		Bougies
Breathing	Bag-valve mask (Adult)	Oxygen delivery devices
	Bag-valve mask (Pead)	Face masks
	Bag-valve mask (Infant)	
	Mechanical Ventilator	Patient circuits
	Capnograph	Collection tubes
	Portable Capnometer	Collection tubes
Circulation	Tourniquets	60 dropper and 10 dropper Intravenous administration sets
	AED with pads	Intravenous catheters (all sizes)
		Syringes (all sizes)
		Hypodermic needles
		Alcohol swabs
		Tape / Plaster
	3 Lead ECG with extra-long leads	Electrodes
		Bandages
		Trauma Pads
Immobilisation	Scoop stretcher	
	Long spine board	
	Spider harness	
	Stokes basket	
	Head blocks and Base plate	
	KED	
Diagnostics	Blood pressure cuff set	
	Glucometer	Glucose test strips
	Pupil Torch	Batteries, bulbs
	Stethoscope	
	Thermometer	
	Vital signs monitor with charger	
	Drug Bag	ALS emergency drugs
	Rescue scissors	

Other	Jump bag	ALS emergency response
	Sharps containers	Nitrile gloves
	Triage Tags	PPE
	Refrigeration/Cold Storage	Burn shield
	Blankets	Disinfectant
Pharmaceutical Agents	Antibiotics / Antiseptics	Broad spectrum
	Analgesia	Morphine
		Fentanyl
	Anaesthetic	Lidocaine local
	Cardiac & Resuscitation Agents	Adrenaline
		Aspirin
		Atropine
		Amiodarone
		Calcium Chloride
		Furosemide
	Intravenous Fluids	Ringers Lactate
		Sodium Chloride
	Sedation, Induction & Paralytic Agents	Diazepam
		Midazolam
		Etomidate
		Ketamine
		Suxamethonium
		Rocuronium
		Vecuronium
	Anti-histamine	Promethazine
	Anti-inflammatory	Ibuprofen
	Anti-emetics	Metoclopramide
	Bronchodilators	Beta 2 stimulants
		Ipratropium Bromide
	Glycaemic Agents	Dextrose 50%
		Insulin
	Comfort Medications	Antacids
		Paracetamol
	Corticosteroids	Hydrocortisone
	Minerals	Sodium Bicarbonate
	Miscellaneous	Anti-tetanus
		Rabies
		Antivenom

Chapter 7 – Limitations

The limitations that exist within this study included the following:

- This was a Delphi study and therefore based on expert opinion only. There are inherent limitations and bias in a Delphi, particularly through each successive iteration as participants move towards common opinions.
- A small number of experts in the field thus a small data set.
- Small response rate.
- Focus on anonymity meant that in each iteration, the initial sample were all involved and individual feedback was not given for each iteration.
- The Delphi methodology does not allow for in-depth analysis of opinions around each item, and while informed inferences were made on the reasons for or against inclusion of the items, true motivation is explored in a limited fashion

Chapter 8 – Recommendations and Conclusions

8.1 Recommendations

It is important that the need for this medical cache is understood (to ensure the health and safety of the members of the search and rescue teams as well as the immediate victims) and that the process is started early to ensure that when the day arrives, the rescue team is well prepared to respond locally or internationally. It is recommended that once this medical cache has been officially established, that it is managed under the provincial administration of the Western Cape Emergency Medical and Rescue Service. The reason for this is that they are already an established department of the provincial government system; meaning that finance could be somewhat easier to obtain; storage and transportation could potentially be arranged via the military or similar government department.

There are plenty of qualified medical Physicians and Advanced life-support Paramedics working within the provincial EMS structure that have the experience, training and willingness to manage this medical cache, although this would be determined by the hierarchy that is in place on the acceptance and implementation of this medical cache.

It is also recommended that the experts that took part in this study be included in the follow-up studies so as to ensure close working relations with each other throughout this process.

It would be ideal if each province were to have their own medical cache or that there is at least a second medical cache available when the other has been deployed; as this would promote rapid deployment to incidents occurring within their provincial boundaries.

8.2 Conclusions

Worldwide environmental degradation and populations are increasing and so is the number of disaster incidences. These increasing threats of disasters are knocking

on the door and it is simply a matter of time before South Africans find themselves involved in a disaster event and a province that is ill-prepared to assist them. It is for these reasons that the provincial authorities need to ensure that the well-being and safety of all members in these communities is protected.

The single medical cache of Rescue South Africa has proven itself of great benefit when assistance has been requested in disaster incidences, whether within South Africa or beyond her boundaries. However to reiterate the importance of obtaining a medical cache, should this cache of Rescue South Africa be deployed internationally or anywhere outside that of the Western Cape or South Africa, there would be no other official cache to take its place. This means that in the event of second disaster taking place concurrently, there would be nothing more than what is currently available to the provincial EMS rescue services, which in many areas is already limited, thereby increasing the community's vulnerability risk. Hence, it may be required to pool equipment across other EMS fields which would be time consuming and create a logistical nightmare for the teams involved.

The moment a disaster has been declared, there is immediately a sense of urgency to respond, it is then the responsibility of the Western Cape Provincial Emergency Medical and Rescue Services to ensure that medical rescue personnel, including canines, are properly trained, prepared and supported by all means possible. In order to uphold this statement, the responding rescue team needs to be suitably equipped. This is to guarantee that they deploy with the correct medical equipment and pharmacological agents so as to provide a quality and timeous service to their fellow community members and anyone else requiring assistance from these Medical and Rescue Services.

This medical cache has been determined based on expert consensus with the aid of FEMA, INSARAG and what is currently available within the Western Cape of South Africa. It is also imperative that we learn from previous disasters and ensure that all is done to properly prepare the provincial communities of South Africa in the event of a disaster.

Disaster preparedness and disaster reduction is to work hand-in-hand to ensure that when future disasters occur; that the destruction, mortality and morbidity are kept to a minimum. Having a medical cache that is fully equipped, maintained and managed correctly will safeguard that the designated search and rescue team is always timeously prepared to respond when called upon. To ensure this local response takes place timeously, it is necessary to have all corresponding policies and guidelines are completed prior deployment.

It would be ideal if each province were to have their own medical cache, as this would promote rapid deployment of EMS to disaster incidences involving the people of South Africa; Africa and upon request, internationally.

Appendix A – Iteration 1

Modified Delphi study to determine the components of a Medical Cache required for local or international response.

1. Equipment

Please indicate which equipment you think is appropriate for the medical cache by selecting one of the following boxes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
AED's	○	○	○	○	○
Arterial Blood Gas Machine	○	○	○	○	○
Bag Valve Mask & Reservoir (Adult)	○	○	○	○	○
Bag Valve Mask & Reservoir (Paediatric)	○	○	○	○	○
Bag Valve Mask & Reservoir (Infant)	○	○	○	○	○
Blood Pressure Cuff Sets	○	○	○	○	○
Blankets (Material blanket)	○	○	○	○	○
Capnograph	○	○	○	○	○
Cricothyroidotomy Kit	○	○	○	○	○
Defibrillator	○	○	○	○	○
: 3 Lead	○	○	○	○	○
:12 Lead with pacing, SaO2 & EtCO2 probes)	○	○	○	○	○
Drug Bag ALS	○	○	○	○	○
Drug Box (ALS)	○	○	○	○	○
Oesophageal	○	○	○	○	○

Detector Device (EDD)					
Glucometers					
Hand Held Suction Device					
Head Blocks and Base Plates					
Jump Bags (ALS)					
KED's					
Laryngoscope Sets					
Long Spine Board					
Magill's Forceps					
Pacing Pads					
PEEP Valve					
Portable Capnometer					
Pupil Torch					
Refrigerator (Small)					
Rescue Scissors					
Scoop Stretcher					
Sharps Containers					
Spider Harness					
Stethoscopes					
Stokes Basket Stretcher					
Syringe Driver (Battery Operated)					
Thermometers					
Tourniquets					

Triage Tags	○	○	○	○	○
Ultrasound Monitor	○	○	○	○	○
Vital Signs Monitor (Full)*	○	○	○	○	○
Ventilator (Air / O2 driven)	○	○	○	○	○

2. Pharmaceuticals

Please indicate which pharmaceuticals you think would be appropriate for the medical cache by selecting one of the following boxes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Broad spectrum antibiotics	○	○	○	○	○
Analgesia: Opioid	○	○	○	○	○
Paracetamol	○	○	○	○	○
Anti-inflammatory	○	○	○	○	○
Anti-emetics	○	○	○	○	○
Antacids	○	○	○	○	○
Antiseptic solutions	○	○	○	○	○
Adrenalin	○	○	○	○	○
Atropine Sulphate	○	○	○	○	○
Amiodarone	○	○	○	○	○
Aspirin	○	○	○	○	○
Beta 2 Stimulants	○	○	○	○	○
Calcium Chloride	○	○	○	○	○
Diazepam	○	○	○	○	○
Dextrose 50%	○	○	○	○	○
Furosemide	○	○	○	○	○
Hydrocortisone	○	○	○	○	○
Ipratropium Bromide	○	○	○	○	○
Midazolam	○	○	○	○	○
Morphine Sulphate	○	○	○	○	○
Nitrolingual Spray	○	○	○	○	○
Promethazine	○	○	○	○	○
Sodium Bicarbonate	○	○	○	○	○

Intravenous Fluids	○	○	○	○	○
Ketamine	○	○	○	○	○
Etomidate	○	○	○	○	○
Depolarizing Paralytic Agent	○	○	○	○	○
Non-depolarizing Paralytic Agent	○	○	○	○	○
Thrombolytic	○	○	○	○	○

Appendix B – Iteration 2

Modified Delphi Study - Medical Cache for USAR, Local & International Response - Round 2							
Equipment			**Strongly Agree**	**Agree**	**neutral**	**Disagree**	**Strongly Disagree**
Airway	Esophageal Detector Device						
Suggested Additional Equipment / Comments							
Breathing	PEEP Valve						
	Capnometer						
Suggested Additional Equipment / Comments							
Circulation	Monitors	AED					
		3 Lead ECG					
		12 Lead ECG					
	Syringe Driver	Battery / Electric					
Suggested Additional Equipment / Comments							
Immobilization	Head Blocks & base plate						
	Stokes Basket						
	KED						
Suggested Additional Equipment / Comments							
Diagnostics	ABG Machine						
	Ultrasound Monitor						
Suggested Additional Equipment / Comments							
Other	Pacing Pads						
	Burn Shield						
	Face Masks						
	Googles						
	Latex Gloves						
	Nitral Gloves						
Suggested Additional Equipment / Comments							
Pharmacology	Calcium Chloride						
	Fentanyl						
	Hydrocortisone						
	Ipatropium Bromide						
	Mannitol						
	Nitrolingual Spray						
	Promethazine						
	Thrombolytics						
Suggested Additional Equipment / Comments							

Appendix C – Iteration 3

Modified Delphi Study - Medical Cache for USAR, Local & International Response - Round 3							
Equipment			Strongly Agree	Agree	neutral	Disagree	Strongly Disagree
Airway	Esophageal Detector Device						
Suggested Additional Equipment /							
Breathing	PEEP Valve						
	Capnometer						
Suggested Additional Equipment /							
Circulation	Monitors	AED					
		3 Lead ECG					
		12 Lead ECG					
	Syringe Driver	Battery / Electric					
	IV Administration Sets	60 Dropper					
		10 Dropper					
		Rate-minder / Dial-a- flow					
Suggested Additional Equipment /							
Immobilization	Kendrick Extrication Device						
Suggested Additional Equipment /							
Diagnostics	Arterial Blood Gas Machine						
	Ultrasound Monitor						
Suggested Additional Equipment /							
Other	Pacing Pads						
	Bum Shield						
	Gloves	Latex					
Suggested Additional Equipment /							
Pharmacology	Calcium Chloride						
	Mannitol						
	Nitrolingual Spray						
	Ondansetron						
	Promethazine						
	Thrombolytics						
Suggested Additional Equipment /							

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
General Comments (Please tick indicate whether you agree or disagree with the adjunct comments)	ECG monitors should be small, rugged and have extra long leads					
	Minimum of 3 lead to assist with the wave morphology in patients with hyperkalemia					
	60 Dropper administration sets instead of infusion devices.					
	Head blocks may be bulky and can be fashioned on scene, therefore stokes and KED may be a better choice					
	ABG machine may be too fragile a device to take along and US may be fine to use but too costly to maintain.					
	Nitryl gloves a better choice compared to latex gloves					
	Personal protective equipment very important					
	12 Lead ECG prefered over 3 Lead ECG monitor.					
	ABG machine an important adjunct					
	Calcium chloride useful in arrythmias due to hyperkalemia. Best if in MDV as pre-filled syringes take up space					
	Fentanyl excellent, given judiciously has limited effect on heamodynamic profile.					
	Hydrocortisone important for own crews as they tend to develop some or other rash.					
	Ipatropium; nitrates; mannitol are nice to have but not a necessity					
	Ondansetron better emetic than promethazine					
	No point in taking Thrombolytics with:					

Appendix D – Results Iteration 1

Modified Delphi Study - Medical Cache for USAR, Local & International Response (Results Round 1)						
* Cut off for consensus = 85%						
Sections	Equipment		Strongly Agree	Neutral	Strongly Disagree	Consensus
Airway	Laryngoscopes		93%	7%	0%	Yes
	Magills Forceps		86%	14%	0%	Yes
	EDD		57%	36%	7%	No
	Suction Device		100%	0%	0%	Yes
	Cric Kit		93%	7%	0%	Yes
Breathing	BVM		100%	0%	0%	Yes
	PEEP Valve		64%	14%	21%	No
	Ventilator		93%	7%	0%	Yes
	Capnograph		93%	7%	0%	Yes
	Capnometer		71%	21%	7%	No
Circulation	Monitors	AED	64%	14%	21%	No
		3 Lead ECG	77%	15%	8%	No
		12 Lead ECG	72%	21%	7%	No
	Syringe Driver	Battery / Electric	54%	31%	8%	No
	Tourniquets		92%	8%	0%	Yes
Immobilization	Head Blocks & base plate		79%	14%	7%	No
	Spine Board	Long	93%	7%	0%	Yes
	Scoop Stretcher		100%	0%	0%	Yes
	Spider Harness		93%	7%	0%	Yes
	Stokes Basket		64%	29%	7%	No
	KED		50%	50%	0%	No
Diagnostics	BP Cuffs	All sizes	100%	0%	0%	Yes
	ABG Machine		36%	36%	29%	No
	Glucometer		100%	0%	0%	Yes
	Pupil Torch		100%	0%	0%	Yes
	Stethoscope		100%	0%	0%	Yes
	Thermometer		86%	14%	0%	Yes
	Ultrasound Monitor		57%	36%	7%	No
	Vital Signs Monitor		86%	14%	0%	Yes
Other	Blankets		93%	7%	0%	Yes
	Drug Bag	Emergency ALS	100%	0%	0%	Yes
	Drug Box	Emergency + Chronic	83%	17%	0%	Yes
	Pacing Pads		57%	21%	21%	No
	Jump Bag	ALS	93%	7%	0%	Yes
	Refrigerator		86%	7%	7%	Yes
	Rescue Scissors		100%	0%	0%	Yes
	Sharps Container		93%	0%	7%	Yes
	Triage Tags		86%	7%	7%	Yes
Pharmacology	Antibiotics	Broad Spectrum	100%	0%	0%	Yes
	Analgesia		100%	0%	0%	Yes
	Anti-inflammatory		86%	14%	0%	Yes
	Anti-emetics		93%	7%	0%	Yes
	Antacids		86%	14%	0%	Yes
	Antiseptics		100%	0%	0%	Yes
	Adrenaline		93%	7%	0%	Yes
	Atropine		93%	7%	0%	Yes
	Amiodarone		86%	14%	0%	Yes
	Aspirin		100%	0%	0%	Yes
	B2 Stimulants		93%	7%	0%	Yes
	Calcium Chloride		80%	13%	7%	No
	Diazepam		93%	7%	0%	Yes
	Dextrose 50%		93%	7%	0%	Yes
	Furosemide		93%	7%	0%	Yes
	Hydrocortisone		79%	14%	7%	No
	Intravenous Fluids		100%	0%	0%	Yes
	Ipatropium Bromide		86%	14%	0%	Yes
	Midazolam		93%	7%	0%	Yes
	Nitrolingual Spray		72%	28%	0%	No
	Paracetamol		100%	0%	0%	Yes
	Promethazine		79%	21%	0%	No
	Soda Bic		93%	0%	7%	Yes
	Induction Agents	Ketamine	100%	0%	0%	Yes
		Etomidate	86%	14%	0%	Yes
	Paralytics	Depol	86%	14%	0%	Yes
		Non-Depol	86%	14%	0%	Yes
	Thrombolytics		29%	36%	36%	No

Appendix E – Results Iteration 2

Modified Delphi Study - Medical Cache for USAR, Local & International Response (Results Round 2)						
* Cut off for consensus = 85%						
Sections	Equipment		Strongly Agree	Neutral	Strongly Disagree	Consensus
Airway	Esophageal Detector Device		64%	27%	9%	No
Breathing	PEEP Valve		64%	27%	9%	No
	Capnometer		82%	18%	0%	No
Circulation	Monitors	AED	82%	18%	0%	No
		3 Lead	64%	18%	18%	No
		12 Lead	82%	9%	9%	No
	Syringe Driver	Electric / Battery	64%	27%	9%	No
Immobilization	Head Blocks & Base Plate		91%	0%	9%	Yes
	Stokes Basket		91%	9%	0%	Yes
	KED		82%	18%	0%	No
Diagnostics	Arterial Blood Gas Machine		27%	55%	18%	No
	Ultrasound Machine		64%	36%	0%	No
Other	Pacing Pads		73%	18%	9%	No
	Burnshield		82%	18%	0%	No
	Facemasks		100%	0%	0%	Yes
	Goggles		100%	0%	0%	Yes
	Gloves	Latex	64%	27%	9%	No
		Nitryl	100%	0%	0%	Yes
Pharmacology	Calcium Chloride		73%	18%	9%	No
	Fentanyl		91%	9%	0%	Yes
	Hydrocortisone		91%	9%	0%	Yes
	Ipatropium Bromide		100%	0%	0%	Yes
	Mannitol		73%	27%	0%	No
	Glyceral Trinitrate		73%	27%	0%	No
	Promethazine		73%	27%	0%	No
	Thrombolytic		27%	46%	27%	No
General Comments	ECG monitors should be small, rugged and have extra long leads. Minimum of 3 lead to assist with t wave morphology in patients with hyperkalemia 60 Dropper administration sets instead of infusion devices. Head blocks may be bulky and can be fashioned on scene, therefore stokes and KED may be a better choice ABG machine may be too fragile a dvice to take along and US may be fine to use but too costly to maintain. Nitryl gloves a better choice compared to latex gloves Personal protective equipment very important 12 Lead ECG prefered over 3 Lead ECG monitor. ABG machine an important adjunct Calcium chloride usefull in arrythmias due to hyperkalemia. Best if in MDV as pre-filled syringes take up space Fentanyl excellent, given judiciously has limited effect on heamodynamic profile. Hydrocortisone important for own crews as they tend to develop some or other rash. Ipatropium; nitrates; mannitol are nice to have but not a necessity Ondansetron better emetic than promethazine No point in taking Thrombolytics with.					

Appendix F – Results Iteration 3

Modified Delphi Study - Medical Cache for USAR, Local & International Response (Results Round 3)						
* Cut off for consensus = 85%						
Sections	**Equipment**		**Strongly Agree**	**Neutral**	**Strongly Disagree**	**Consensus**
Airway	Esophageal Detector Device		63%	25%	12%	No
Breathing	PEEP Valve		63%	25%	12%	No
	Capnometer		100%	0%	0%	Yes
Circulation	Monitors	AED	88%	0%	12%	Yes
		3 Lead	88%	12%	0%	Yes
		12 Lead	63%	25%	12%	No
	Syringe Driver	Electric / Battery	75%	25%	0%	No
	IV Administration Sets	60 Dropper	63%	37%	0%	No
		10 Dropper	75%	25%	0%	No
		Rate Minder / Dial-a-flow	75%	12%	12%	No
Immobilization	KED		88%	12%	0%	Yes
Diagnostics	Arterial Blood Gas Machine		50%	38%	12%	No
	Ultrasound Machine		75%	25%	0%	No
Other	Pacing Pads		50%	50%	0%	No
	Burnshield		100%	0%	0%	Yes
	Gloves	Latex	63%	0%	37%	No
Pharmacology	Calcium Chloride		75%	13%	12%	No
	Mannitol		38%	38%	24%	No
	Glyceral Trinitrate		63%	37%	0%	No
	Odansetron		63%	37%	0%	No
	Promethazine		63%	37%	0%	No
	Thrombolytic		12%	38%	50%	No

		Strongly Agree	Neutral	Strongly Disagree
General Comments (For Round 2)	ECG monitors should be small, rugged and have extra long leads.	100%	0%	0%
	Minimum of 3 lead to assist with the wave morphology in patients with hyperkalemia	86%	14%	0%
	60 Dropper administration sets instead of infusion devices.	14%	71%	14%
	Head blocks may be bulky and can be fashioned on scene, therefore stokes and KED may be a better choice	71%	14%	14%
	ABG machine may be too fragile a dvice to take along and US may be fine to use but too costly to maintain.	43%	43%	14%
	Nitryl gloves a better choice compared to latex gloves	57%	43%	0%
	Personal protective equipment very important	100%	0%	0%
	12 Lead ECG prefered over 3 Lead ECG monitor.	43%	43%	14%
	ABG machine an important adjunct	57%	29%	14%
	Calcium chloride usefull in arrythmias due to hyperkalemia. Best if in MDV as pre-filled syringes take up space	100%	0%	0%
	Fentanyl excellent, given judiciously has limited effect on heamodynamic profile.	100%	0%	0%
	Hydrocortisone important for own crews as they tend to develop some or other rash.	71%	14%	14%
	Ipatropium; nitrates; mannitol are nice to have but not a necessity	43%	29%	29%
	Ondansetron better emetic than promethazine	57%	29%	29%
	No point in taking Thrombolytics with.	86%	14%	0%
	Only 7 of the 8 responses commented here.			

General Comments (For Round 3)	EtCO2 prefered
	An AED is a must have
	3 Lead ECG is easier to use in situations of trapped patients
	12 Lead ECG is bulky and expensive and is hard to use in confined spaces
	Battery operated syringe driver is useful in confined spaces
	Dial-a-flow device provides more control over other devices
	KED is unlikely to be useful in confined spaces
	ABG machine is expensive and hard to maintain
	Ultra sound machine could be useful in chest injured patients
	Burnshields useful
	Latex gloves are a potential for allergic reactions
	Calcium chloride useful for crush injuries
	Mannitol may be difficult to use in the field as urine output needs to be monitored
	Gyceral Trinitrate may be useful
	Ondansetron is very useful and prefered over Promethazine
	Thrombolytics are hard to justify and expensive

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PART: B

ORIGINAL PROTOCOL

Modified Delphi study to determine the components of a Medical Cache required for local or international medical deployment after a major incident or disaster

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This study is in partial fulfilment of the M. Phil: Emergency Medicine degree

TABLE OF CONTENTS

Abstract

Introduction

Disasters occur without warning and have the potential to cause chaos and destruction in unsuspecting communities and the environment. The medical personnel of the Western Cape Emergency Services are willing and able to respond to major incidents or disasters, but lack the support of a standardized Medical Cache. A medical cache is a compilation of medical equipment and pharmaceuticals that accompany a medical response team who in turn provide triage and medical care at the incident or disaster site. Currently there is only one medical cache in South Africa, which is stored in Johannesburg and belongs to the Rescue South Africa Organization. The lack of a suitable medical cache, which can be easily deployed should the need arise, is compromising the preparedness of medical teams from the Western Cape to deploy to Major Incidents and or Disasters outside of the provincial boundaries. The aim of this study is to obtain consensus as regards what such a cache should be comprised of.

Methodology

A three round modified Delphi study will be conducted over three months (01 June 2012 – 31 August 2012), during which time, selected experts who are currently working in the field of disaster response and emergency medicine, will be asked to voluntarily and anonymously complete three rounds of questionnaires. After each round the responses will be collected and analyzed by the primary researcher and new questions will be formed for the subsequent rounds.

Conclusion

It is the responsibility of Provincial Emergency Medical Services to ensure that all has been done to properly prepare and support medical personnel who may be required to deploy as part of a medical response to a disaster situation. The aim of this research is to inform a medical cache that will support the operation of these medical teams. They will require a well-established and appropriately stocked medical cache that will be stored in a secure and reasonable location, so as to facilitate rapid deployment.

1. Introduction

Disasters may be defined as "an event that occurs and overwhelms the local community's capacity to cope, therefore requiring external resources".[1] Whether man-made or the result of an environmental assault, disasters are ever increasing and part of the environment we currently find ourselves in.[2] They have the potential to induce a profound impact on the environment, the people, as well as on the surrounding infrastructure.

Disasters will continue to occur as urbanization increases and the environment degrades further. Each year sees more than 35 million people displaced from their homes due to disasters and conflict.[2,3] National and international coordinated strategies for risk reduction, risk management and disaster preparedness are needed to limit potential fatalities and destruction from future disasters.[3] It is therefore essential that when these disasters do occur that the designated medical response teams have a fully equipped medical cache that will be ready for deployment, as this will aid in reducing morbidity and mortality during disasters.[4]

A medical cache that is equipped with the relevant medical equipment, including limited surgical equipment and pharmaceuticals will allow medical members of a deployed team to provide the required level of care to victims of the disaster, as well as the rescue team (inclusive of canine members), during an urban search and rescue incident.

1.1 Definition of Terms

FEMA: Federal Emergency Management Agency

INSARAG: International Search and Rescue Guidelines

USAR: Urban Search and Rescue

1.2 Literature review

The Disaster Management Act of South Africa (No 57 of 2002) aims at providing an integrated and coordinated policy that describes the phases of a disaster, which include the Pre-Disaster Risk Reduction and the Post-Disaster Risk Recovery phases.[6] Each province is responsible for establishing a disaster management framework to guide the development of measures that will decrease the provinces vulnerable areas and communities. Currently there is no permanent staff establishment within the Western Cape that can respond to any disasters[7] and

therefore individuals from various emergency and health services from within South Africa may need to be or have been deployed.

Disasters are unpredictable by nature and may constitute the following.[3,8]

Natural Disasters	Human Activities
Cyclones	Terrorist Attacks
Droughts	Accidental / Human Error
Earthquakes	Civil Strife
Floods	Refugees / Internally Displaced
Landslides	Epidemics
Storms	
Volcanic Eruptions	
Wildfires	

Table 1: List of potential natural and human activities leading to disasters

Below reports that of the 373 natural disasters that occurred worldwide in 2010, 296 800 people lost their lives[9]; this however, is expected to escalate in the future as climate change increases and the rate of urbanization increases.[2,3] The South African natural disaster statistics between 1980 – 2010 reported that an average of 60 people were killed per year.[10] Where the African disaster statistics from 1980 – 2008 reported an average of 24 438 people killed per year.[11] It has been reported that Africa is unprepared to respond to any disaster situation on the continent, as they have insufficient capacity to predict, monitor, handle or mitigate disasters.[12]

After the 2010 deployment to Haiti, experts proposed that a single, all-inclusive, cross-sector, multi-disciplinary medical rescue team be developed, that will be trained and equipped for response to local and if required international disasters. This was brought about because members of the South African medical team reported feelings of inadequacy as their team arrived in Haiti with limited support, communication and supplies.[13]

Ineffective resource allocation could limit the ability to deliver timeous resources to disaster areas in the correct quantities.[14] This applies to humanitarian responses but

can also be applied to Search and Rescue Response Units deployed to local and national disaster areas as the same principles apply when preparing for deployment. Thomas and Kopczak determined that a good medical cache could be achieved by including activities such as preparedness, planning, procurement, transport, storage, tracking, tracing and the procedures to be followed for clearance through customs.[15]

While conducting a literature search on this topic, search terms such as South African medical cache; South African Military medical cache; Medical cache; FEMA; INSARAG; USAR medical caches; were used and it was determined that minimal research exists for any South African medical caches. The International agencies FEMA[3] and INSARAG[5], were amongst the only two established agencies with a set of guidelines, suggesting the type, amount and cost of medical equipment and pharmaceuticals that should be deployed when responding to a disaster site. Information provided by the USAR teams of Queensland and documentation on the Push Packages of the United States of America were identified in the literature, but offered little assistance as they too are based on the above FEMA or INSARAG guidelines. It was however discovered that currently there is only one medical cache in South Africa. This is managed by Rescue South Africa and is stored in Johannesburg.[16] Anecdotally; this medical cache was developed by a team of doctors and paramedics, and was not evidence based. Rescue South Africa provides technical and emergency medical care to those in need during a disaster situation, and will respond with their cache from Gauteng. This is of great benefit when a disaster does occur, but should this cache be deployed internationally or to another province there would be nothing to replace it. It would therefore be ideal if each province were to have their own medical cache, as this would promote rapid deployment to incidents occurring within their provincial boundaries and beyond.

Rescue South Africa has responded to a number of incidents in the past few years, these include: [16]

Year	Country of Disaster	USAR	Humanitarian	Aid Assessment
1999	Turkey	X		
2000	Southern Mozambique		X	

2001	India	X		
2002	Democratic Republic of Congo			X
2003	Algeria	X		
2003	Iran	X		
2005	Pakistan	X		
2010	Haiti	X	X	
2010	Congo	X		

USAR teams are requested to deploy as soon as assistance from the affected country has been requested.[17] Delays may be a result of bad planning, resulting in poor preparedness by team managers and members, causing unnecessary delays.[18]

Responding to disasters may be a costly undertaking and the time attached to securing the release of funds is often unreliable. The Public Finance Management Act of 1999, states that in an emergency, funds will be released for use, and the National, Provincial and Local organs of state may also contribute financially to response efforts. A percentage of the budget of a provincial or municipal organ of state, may be required and so requested.[9] As all these processes are time consuming with miles of red tape to unravel, it would therefore be of benefit that the equipment and medical cache be prepared ahead of time, so that deployment is not delayed.

Therefore, once a permanent team has been established and a dedicated medical cache set up, it will enable the team to provide a rapid response once activated. The establishment of a medical cache must include protocols for sourcing the medical equipment, pharmaceuticals for human and canine use, storage, transportation and accountability.

1.3 Motivation for study

The medical rescue personnel of the Western Cape Emergency Services are highly trained in multiple rescue modules and may be deployed at short notice to disasters whether local, national or international. Currently there is no state managed medical cache established for this and therefore an evidence based approach is required to

determine the most appropriate equipment, pharmaceuticals and surrounding logistics necessary to establish a medical cache that can be state or provincially managed to ensure appropriate and timely deployment when disasters occur.

1.4 Research question

What equipment and pharmaceuticals are required for the development of a medical cache, for local, provincial and if required international response, by the Western Cape Emergency Medical Rescue Teams?

1.5 Aim

To inform a medical cache that will incorporate all the relevant equipment and pharmaceuticals that will be ready for immediate deployment or within 6 hours[16] of a disaster occurring locally or extending into areas of Africa.

1.6 Objectives

- To determine the core equipment for a medical cache for use by the Western Cape's Emergency Medical Rescue teams.
- To determine the core pharmaceuticals required for a medical cache to be used by the Western Cape's Emergency Medical Rescue teams.

2. Methods

2.1. Study design

A 3 round modified Delphi method will be used for obtaining consensus on what equipment and pharmaceuticals should be part of a medical cache for the Western Cape Emergency Medical Rescue Teams. The study will be conducted over three months (01 June 2012 – 31 August 2012).

2.2 Study population

National and international experts in the discipline of disaster medicine and with the relevant experience in medical response to major incidents or disasters will be approached to form part of the study. The same questionnaire will be distributed to each of the participating experts irrespective of their qualifications.

2.3 Sampling

At least 20 selected experts in the field of disaster medicine, emergency medicine or pre-hospital medicine will be invited to participate in the study. These participants must have had previous experience in medical cache designs or use thereof, for urban search and rescue response to local, national or international disasters and should preferably be currently working in either of these fields.

2.3.1. Inclusion criteria

- These experts will include local, national and international persons who have been personally involved in previous deployments and in the design of a medical cache for the purpose of urban search and rescue and who are currently working within the field of disaster medicine, emergency medicine or pre-hospital medicine. Those participants working in the field of disaster medicine will include professors, and doctors who have had experience in policy making or in the development of guidelines. The emergency medicine participants will include emergency registrars and other doctors; while those participants of pre-hospital medicine will include emergency registrars and paramedics working in this field. These experts will be identified through the pre-hospital and disaster management network and recommendations on others from these persons identified.
- Those that were not involved with the designing or packing of a medical cache but were deployed with and used a medical cache will be included in the study.

2.3.2. Exclusion Criteria

- Emergency practitioners that may have responded to disasters or major incidents but played no role in the direct or indirect provision of medical care will be excluded from the study.
- Those that have been involved in either the packing or design of a medical cache but were not deployed with it will be excluded from the study.

2.4 Data collection and management

The first round of the study will involve the distribution of collated lists which have been obtained from the guidelines of FEMA and INSARAG. Each of these experts will be asked to mark off what equipment and pharmaceuticals they deem necessary for a medical cache to contain, utilizing a Likert Scale. Their comments on types of

cold chain storage will also be sought. As international members will be supplied with these questionnaires it may not be viable to add the costs of each item during the initial rounds. Once a list has been agreed upon, costs can then be investigated and drawn up to form part of the final document.

The completed questionnaires, once returned via email, will be collected and opinions analysed by the primary researcher. Following this, a second set of questions will be extrapolated from the consensus of the first round and these will again be sent to the participating experts. After the second round, the expert's answers will be synthesized and a third set of questions will be developed. These questions will then be presented to each participant for a third time. A group consensus regarding the medical cache for local and national response will then be determined based on all the above information.

These questionnaires will be conducted in English and all participants will be informed about the purpose of the study before asking them to voluntarily participate. The questionnaire will consist of a structured list of items of which the participants are required to tick off which equipment and pharmaceuticals they deem necessary to be included in the medical cache (Appendix 1 and 2). A second questionnaire (Appendix 3) will include selected open-ended questions with a Likert scale and a comment section.

Collected data will be transferred onto an electronic data sheet (Microsoft excel®, Microsoft Corporation, Redmond, WA). This will be password protected to ensure the integrity of the data and all data sheets will be stored in a safe that is locked until the end of the study, after which the data sheets will be destroyed. The data collected will only be made available to the primary researcher and the supervisors of the study. Data will be backed up on an external USB storage device which will only be accessible to the primary researcher and if required, to the supervisor upon request.

2.5 Timeline

2012	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposal	X								
Ethics		X							
Interviews (Data Collection)			X	X	X				
Transcribing of Data							X		
Data Analysis						X			
Compilation of Final Report							X	X	
Submission									X

3. Statistical and data analysis

Descriptive statistics, medians and ranges, bar charts and frequency distribution will be used to determine the distribution of responses from each of the experts.

The initial information elicited from the questionnaires will be analysed by removing duplicates and listing the factors from each expert. The responses will be recorded on a consolidated list, which will be grouped into categories to make it easier for the experts to work with when returned for the next interview.

The second questionnaire will be used to validate the first; it will ask the experts to substantiate what has been interpreted by the researcher as well as an opportunity to refine the responses if required. The expert groups will then narrow down the information to facilitate consensus.

Once all information is returned and synthesized a third questionnaire will be developed which will indicate the group's judgment and their reasoning.

4. Ethical and legal considerations

This is a low risk Delphi study and no personal or identifying details of participants will be collected.

Confidentiality will be maintained by limiting the annotated results from the interviews and questionnaires to the primary researcher and supervisors of the study. Consent forms (Appendix 4) will be obtained from all participants via emails prior the interviews and distribution of questionnaires. The selected experts will maintain their anonymity and only the primary researcher will know which responses belong to

which expert. Each participant will have the opportunity to withdraw from the study at any point of the study.

5. Limitations

The limitations that exist within this proposal include the following:

- Bias, as this is a Delphi study and is based on expert opinion only, but will be useful for this setting as it can be regarded for future studies. A non-validated open-ended questionnaire will be presented to the group of experts.

6. Resources

6.1. Available Resources

	Description	Source
1	Consumables	Primary Researcher
2	Travel Services	Primary Researcher
3	Telephone Communication	Contact Centre of the Western Cape Department of Health EMS; Primary Researcher
4	Email Communication	Primary Researcher
5	Computer use	Primary Researcher
6	Printing and Photocopying	Primary Researcher

6.2 Budget

Budget - January – August 2012				
ITEM	**DESCRIPTION**	**UNIT COST**	**UNITS REQUIRED**	**TOTAL COST**
Consumables				
Office Supplies	**Paper**	**R50 / Ream**	**2**	**R100.00**
Printing	**Reproduction for reports**	**R0.40 / page**	**1000**	**R400.00**

Printing Ink		**R275.00**	**2**	**R550.00**
Travel				
Travel to Sites*	**Travel Cost**	**R3.61 / km**	**300**	**R1 083.00**
TOTAL				**R2133.00**

* Travel will be required when meeting with supervisors and if required to meet with local participants of the study.

7. Reporting and implementation of results

Upon conclusion of the study, the results will be made available to the management and the Western Cape Provincial Department of Health, the University of Cape Town's Division of Emergency Medicine and other training institutions. It will also be submitted for consideration for publication in a peer-reviewed journal. The outcomes of this study will serve as the basis for the future design and establishment of a medical cache for the Western Cape Urban Response Team (WCURT).

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Appendix 1

Questionnaire 1: Equipment

Please indicate which equipment you think is appropriate for the medical cache by selecting one of the following boxes.

***SD- Strongly disagree; D- Disagree; N- Neutral; A- Agree; SA- Strongly agree.**

ITEM	SD	D	N	A	SA
AED's					
Arterial Blood Gas Machine					
Bag Valve Mask & Reservoir (Adult)					
Bag Valve Mask & Reservoir (Paediatric)					
Bag Valve Mask & Reservoir (Infant)					
Blood Pressure Cuff Sets					
Blankets (Material blanket)					
Capnograph					
Cricothyroidotomy Kit					
Defibrillator : 3 Lead					
:12 Lead with pacing, SaO2 & EtCO2 probes)					
Drug Bag (ALS)					
Drug Box (ALS)					
Esophageal Detector Device (EDD)					
Glucometers					
Hand Held Suction Device					
Head Blocks and Base Plates					
Jump Bags (ALS)					
KED's					
Laryngoscope Sets					
Long Spine Board					
Magill's Forceps					
Pacing Pads					
PEEP Valve					
Portable Capnometer					
Pupil Torch					
Refrigerator (Small)					
Rescue Scissors					
Scoop Stretcher					
Sharps Containers					
Spider Harness					
Stethoscopes					
Stokes Basket Stretcher					
Syringe Driver (Battery Operated)					
Thermometers					
Tourniquets					

Triage Tags						
Ultrasound Monitor						
Vital Signs Monitor (Full)*						
Ventilator (Air / O2 driven)						

Other:

_____

_____

_____

_____

_____

Appendix 2

Questionnaire 2: Pharmaceuticals

Please indicate which pharmaceuticals you think would be appropriate for the medical cache by selecting one of the following boxes.

***SD- Strongly disagree; D- Disagree; N- Neutral; A- Agree; SA- Strongly agree.**

ITEM	SD	D	N	A	SA
Broad spectrum antibiotics					
Analgesia: Opioid					
Paracetamol					
Anti-inflammatory					
Anti-emetics					
Antacids					
Antiseptic solutions					
Adrenalin					
Atropine Sulphate					
Amiodarone					
Aspirin					
Beta 2 Stimulants					
Calcium Chloride					
Diazepam					
Dextrose 50%					
Furosemide					
Hydrocortisone					
Ipratropium Bromide					
Midazolam					
Morphine Sulphate					
Nitrolingual Spray					
Promethazine					
Sodium Bicarbonate					
Intravenous Fluids					
Ketamine					
Etomidate					
Depolarizing Paralytic Agent					
Non-depolarizing Paralytic Agent					
Thrombolytic					

Other:

_____

_____

_____

Appendix 3:

CONSENT FORM FOR PARTICIPANTS OF A DELPHI STUDY

TITLE: **Modified Delphi study to determine the components of a Medical Cache required for local or international medical deployment after a major incident or disaster**

INTRODUCTION:

Disasters occur without warning and have the potential to cause chaos and destruction in unsuspecting communities and the environment. The medical personnel of the Western Cape are willing and able to respond to major incidents or disasters, but lack the support of a standardized Medical Cache.

AIM OF THIS STUDY:

To inform a medical cache that will incorporate all the relevant equipment and pharmaceuticals that will be ready for immediate deployment or within 6 hours[18] of a disaster occurring locally or extending into areas of Africa.

METHOD:

A 3 round modified Delphi method will be used for obtaining consensus on what equipment and pharmaceuticals should be part of a medical cache for the Western Cape Emergency Medical Rescue Teams. The study will be conducted over three months (01 June 2012 – 31 August 2012).

Your role in this study:

You would be required to voluntarily complete three rounds of questionnaires that will be distributed via email. These questionnaires will in the form of checklists to be ticked with a comment section underneath if needed.

Please indicate by ticking the appropriate box:

	YES	NO
1. Do you understand the purpose or aim of this study?	□	□
2. Have you been coerced into partaking in this study?	□	□
3. Do you agree to partake in this study?	□	□

INITIAL & SURNAME: _____ DATE: ____/_____/_20_____

ETHICS APPROVAL HREC

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Ms S Ariefdien - Tel: [021]4066492 • Fax: [021]4066411
email: sumayah.ariefdien@uct.ac.za

23 May 2012

HREC REF: 241/2012

Ms N Seymour,
Emergency Medicine
Surgery
Omb

CC. Dr HI Geduld
Emergency Medicine
J Floor, Old Main Building

Dear Ms Seymour,

PROJECT TITLE: MODIFIED DELPHI STUDY TO DETERMINE THE COMPONENTS OF A MEDICAL CACHE REQUIRED FOR LOCAL OR INTERNATIONAL MEDICAL DEPLOYMENT AFTER A MAJOR INCIDENT OR DISASTER

Thank you for submitting your new study to the Faculty of Health Sciences Human Research Ethics Committee

It is a pleasure to inform you that the Ethics Committee has formally approved the above-mentioned study.

Approval is granted until 28 May 2013

Please submit an annual progress report (FHS016) if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file (FHS010).

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR MARC BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.